Printed on Thin Paper for Foreign Circulation.

"THE ENGINEER" NOVEMBER 25, 1932.

With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLIV.—No. 4011] LONDON: FRIDAY, NOVEMBER 25, 1932 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

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Civil Service Commission.

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By Order,
C. ERIC STADDON,
Clerk of the Council.

Town Hall,
Beckenham, Kent,
November 14th, 1932. 9172

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WALTER MOON,
Town Clerk.

Town Clerk's Office, Liverpool,
November, 1932. 9184

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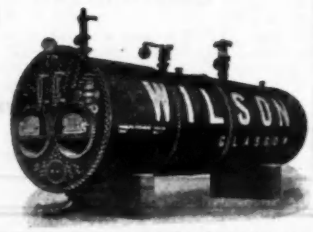

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A Seven-Day Journal

The Veteran Cars.

Up till 1896 no motor car could be driven in England at a speed greater than 2 miles per hour, and each had to be preceded by a man carrying a red flag. In that year the restriction was removed, and to celebrate their release motorists of that date organised a run from London to Brighton, which took place on November 14th, 1896. Quite a large percentage of the entrant cars actually arrived at Brighton! Last Sunday the Commemoration Run for Veteran Cars, which is now held annually to celebrate Emancipation Day, 1896, took place, the "youngest" car having been built in 1904. We ourselves observed their progress from the seats of a more modern vehicle. Though we started but half-an-hour after the first "old crock" left the starting point, we only reached Brighton a few minutes before the first veteran arrived. Indeed, it was only with difficulty that we managed to keep up with some of them. The 50 H.P. four-cylinder Napier racing car, built in 1903, more than kept pace with us for 10 miles, but when we last saw it Croydon hill had apparently been "too much" for it. Another veteran passed us, downhill, at 35 miles per hour, but we were left in some doubt as to its real capabilities, since its brakes did not appear to be functioning very satisfactorily. A Thornycroft car built in 1904, and driven by Mr. Tom Thornycroft, was the first veteran home, and altogether out of the sixty-one entrants no less than fifty-one eventually reached Brighton.

The Proposed Forty Hours' Week.

At meetings which were held in York during last week both the Amalgamated Engineering Union and the Engineering and Shipbuilding Trades Federation decided to support and promote a movement for a forty hours' working week, without any reduction in wages. The Engineering and Shipbuilding Trades Federation further decided to approach again Shipbuilding Securities, Ltd., and to insist on a consultation before any more yards were acquired and closed, with a view to finding out whether shipbuilders could create other industries and could provide for the transference of skilled and other workmen to other shipbuilding centres or pay compensation to men displaced. It was also agreed to approach the Government and the heads of departments and to lay before them the urgent need for steps to be taken to provide employment in the shipbuilding industry during the coming months, also to request the Government to facilitate the placing of its own orders and to bring forward work already scheduled by the Admiralty. The suggestion was made that a loan should be floated at low rates of interest to buy up redundant vessels for breaking up and holding the scrap until the market improves. The meeting finally decided to press for an extension of every possible facility for building for Russia special vessels, such as ice-breakers, dredgers, river boats, and heavy tug boats. The meeting expressed its determination to oppose any reduction in railway shopmen's wages, and agreed to co-operate with other trade unions in resisting such reduction.

Galway Sea and Air Port.

Since 1927 an effort has been made to popularise the port of Galway on the West Coast of Ireland as a Transatlantic port, and already a number of British and German shipping lines have made it a port of call. A new scheme, in which the Governments of Great Britain, Canada, and the Irish Free State are said to be interested, is now being promoted by the Irish Transatlantic Corporation, Ltd., for the construction of a large harbour with an adjoining air port. Sir John P. Griffith, M. Inst. C.E., has prepared the plans of the proposed harbour, and has drawn up a report on the financial side of the undertaking, which is being examined by the technical advisers of the various Governments interested in the scheme. The design of the air port has been entrusted to Mr. Maxwell Ayrton, and it is understood that an aerodrome with facilities equal to those of Croydon is contemplated. The chairman and managing director of the new company is Mr. C. H. Glendining, who is dealing with the various arrangements, including negotiations with the London, Midland and Scottish Railway and the Great Southern of Ireland Railway with regard to railway communications with Galway. The cost of the scheme is estimated at a minimum of £2,500,000.

London's Bridges and Approaches.

In a lecture delivered before the London Society on Friday last, November 18th, Professor S. D. Adshead, Professor of Town Planning at the University of London, dealt in an interesting way with the whole of the bridges within the London area. The trouble, he said, was not the bridges, but their approaches, and any attempt to deal with the traffic problem would be futile unless the bridge approaches were effectively dealt with. Before spending vast sums of money on new Thames bridges, Professor Adshead suggested that a definite plan ought to be made as regards the terminal stations of the Southern Railway. In this connection, Cannon-street Station, Blackfriars Railway Bridge, Holborn Station, and Charing Cross Railway Bridge ought, he suggested, to be done away with, and their place taken by duplicated systems of electrified underground circling lines. The Charing Cross and Waterloo Bridge proposals should, he thought, be faced with the clear assumption that the approach to Charing Cross Railway Station would be underground. In order to relieve the increased traffic on Waterloo Bridge, Professor Adshead suggested that a narrow bridge should be thrown across the river at the foot of Norfolk-street. In view of the proposal to make a central London air port, with a river aerodrome, both the Norfolk-street and the Charing Cross bridges ought, he argued, to be suspension bridges, so that any river obstruction might as far as possible be avoided.

The Mersey Tunnel.

In the course of a statement made by Sir Thomas White, who, last week, was re-elected chairman of the Mersey Tunnel Joint Committee, it was revealed that the Committee is now aware of the amount of excess expenditure up to the present, but that it cannot say with any degree of accuracy that the end has been reached. Sir Thomas expressed his regret that the Ministry of Transport had found itself unable to assist the Committee by granting 50 per cent. of the additional money required, but he said that the Committee was discharging its obligations to residents on both sides of the river by attempting to get the Government to consent to a clause which would have the effect of providing some relief to the rates if prosperity attended the undertaking. Endeavours were also being made to extend the period during which the tolls could be collected. The Committee has provisionally accepted the following tenders for the building of three ventilating stations, which figures include the cost of steel work:—New Quay, Liverpool, Henry Boot and Son, Ltd., of Sheffield, £26,316; Sidney-street, Birkenhead, Robert MacAlpine and Sons, Ltd., £76,928; and Taylor-street, Birkenhead, Henry Boot and Sons, Ltd., £30,306. Agreement has also been reached on the question of the use of the ferries after the expiration of twenty-one years from the opening of the tunnel.

A North London Bridge Replacement.

During the night of Saturday to Sunday last, November 19th–20th, the old 120-ton bridge carrying the L.M.S. Railway over the Edgware-road at Cricklewood was rolled bodily out of place and a new 180-ton structure rolled in to replace it. A month's preparatory work by the company's engineers and the staff of Dorman, Long and Co., Ltd., the contractors, had been necessary to enable the old and new bridges to be exchanged in a single night. Steel trestles with a total length of 120ft. were erected in the Edgware-road, and on top of them the new bridge was assembled girder by girder until ready to be rolled into position. Late on Saturday night the old bridge was jacked up on to roller bearings running on grooved rails and was then rolled out of its place, while the new bridge, which was also mounted on roller bearings, was rolled into position. The new bridge, which has been constructed to carry the heaviest locomotives, was then secured and by 10.30 a.m. on Sunday morning was ready for trains to run over it. The final stage of the change-over will be carried out this week, when the old bridge will be dismantled on the trestling and removed in sections, which next Sunday, November 27th, will be loaded by cranes on to rail trucks standing on the new bridge, and carried away. The new bridge is composed of two outer main girders with plate parapets 78ft. 6in. and 79ft. long, 7ft. deep over main angles, and spaced at 28ft. centres. The floor is constructed of cross girders spaced 4ft. centres between which, ½in. thick floor plates are provided. The cross girders and floor plates are stiffened by four lines of diaphragms extending the length of the bridge and situated under each rail. The work has been carried out by the L.M.S. District Engineer, Mr. F. J. Greasley, under the supervision of Mr. A. Newlands, the Chief Civil Engineer.

Liquid Fuel from Coal.

On Tuesday, November 22nd, the Norman Lockyer lecture of the British Science Guild was delivered by Sir Frank Smith, F.R.S., Secretary of the Department of Scientific and Industrial Research, who took as his subject "Industrial Research and the Nation's Balance Sheet." In the course of his lecture Sir Frank stated that Nature had well provided us as a nation with potential energy. We had abundance of coal—certainly not less than 100,000,000,000 tons remained unmined. Notwithstanding this abundance of coal, we imported fuel from abroad. Motor spirit valued at £13,000,000 was bought last year; next year the same quantity might cost us £26,000,000. Of all known processes of treating coal to produce a liquid fuel hydrogenation stood out conspicuously from the rest, inasmuch as a No. 1 grade petrol could be produced as the main product. In this country the Fuel Research Board had investigated many aspects of the problem of hydrogenation, paying particular attention to the catalysts, and experiments on a very large scale had been carried out by Imperial Chemical Industries. To many progress might appear to have been very slow, but when it was considered that five or six years ago the cost of producing petrol from coal by hydrogenation was estimated to be not less than 2s. 6d. a gallon, whereas to-day the estimate was 9d. a gallon, the rate of progress had, he thought, been very remarkable. This 9d. a gallon was the price ex works, and was comparable with imported petrol at Thames mouth at about 6½d. a gallon. It would be observed that there was a difference in price of 2½d. in favour of the imported spirit, but it was well to remember that in 1920 the retail price of petrol less tax was 3s. 5d. a gallon and as late as 1930 it was 1s. 2½d.

Shipowners and Road Transport.

In response to a request by Mr. P. J. Pybus, the Minister of Transport, the Chamber of Shipping has forwarded to him its observations on the Rail-Road Conference Report. The letter states that while, in the main, the shipping industry is not competitive with either rail or road transport, and its primary interest is to see that full advantage is taken of all forms of internal transport, whether by rail, road or water, inland and coasting, it considers the proposal of the Conference for increased contributions from commercial road hauliers is fully justified and desires to support it. The Chamber feels that any proposals for controlling by regulation the wages and conditions of employment of drivers, or imposing machinery for their regulation, would require to be seriously weighed before these proposals could be adopted in the national interest. It is of the utmost importance, the Chamber suggests, that the factor of cost of all forms of transport should not exceed the corresponding factor of cost in the producing and exporting industries on which the country depends. Support is extended by the Chamber to the suggestion of the Conference for promoting collaboration on a voluntary basis between rail and road transport acting as separate units, and also in collaboration with coasting owners.

The Mid-East England Grid Scheme.

Reference has already been made in these columns to the grid scheme for the Mid-East England area. The construction of the stations and distribution scheme now being completed, the Central Electricity Board has notified the authorised undertakers that trading operations can begin on January 1st, 1933. There are sixteen selected stations, the principal stations being Ferrybridge, Rotherham, Kirkstall, Thornhill, Blackburn Meadows (Sheffield), Hull, and Bradford. Among these stations are two of recent construction—Kirkstall and Ferrybridge—which are among the most efficient in Great Britain; they have reached an overall thermal efficiency per unit generated in excess of 23 per cent., the national average being about 16 per cent. The sixteen stations are interconnected by main transmission lines operating at 132,000 volts, with extensions north to link up with the North-East England area, west to link up with North-West England, and south to link up with South-East England. A secondary system at 33,000 volts has been developed to open up agricultural districts in Southern Lincolnshire and Rutland. The mileage of main transmission lines as completed amounts to 323 miles, and of secondary lines to 202 miles, giving a total of 525 miles in the scheme area.

Wireless Equipment for the Cross-Channel Air Services.

A "Micro Ray" equipment, similar to that described in our issue of April 10th, 1931, has been ordered by the Air Ministry for use in connection with the cross-Channel flying services. The apparatus will be manufactured by Standard Telephones and Cables, Ltd., and owing to the fact that it will operate on a wave-length of about 15 cm., the transmitting and receiving aerials will be less than 1in. long. It will be remembered that those exceptionally short waves are generated by a special "Micro-Radion" tube and that a circular reflector about 10ft. in diameter is used to focus the waves on a similar reflector at the receiving station. The new equipment for use in this country will be installed at the Lympne air port near Hythe, and will operate in conjunction with a similar equipment ordered by the French Air Ministry and to be situated at St. Inglevert Aerodrome, nearly 7 miles south-west of Calais. The apparatus will be used for announcing the arrival and departure of aeroplanes that are not fitted with wireless gear and for routine service messages. An interesting feature of the new service will be the use of teleprinters for receiving and transmitting messages. In this way typewritten messages will be sent across the Channel by wireless, thus providing a permanent record at each end. The use of teleprinters will also help to overcome the language difficulty, as it is easier for a man to understand a written message in a language with which he is unfamiliar than a spoken one. Messages can also be received on a teleprinter during the absence of the operator. The great advantage of the very short waves is that they are almost unaffected by atmospheric conditions and there is practically no interference owing to congestion of the ether or from nearby machinery.

Mallet Type Locomotives.

By E. C. POULTNEY.

No. II. (*Conclusion*).*

Simple Expansion Mallets.

We now consider Mallet engines with four simple expansion cylinders, and one of the earliest examples is seen in the large locomotives built by both the American Locomotive Company and Baldwins for the Chesapeake and Ohio—Fig. 2. These engines are practically two consolidations under one boiler, having four 23 by 32 cylinders, 57in. driving wheels, a working steam pressure of 205 lb., giving a total rated tractive force of 103,500 lb. The illustration shows one of the later Baldwin engines, which differ slightly from the earlier design by the American Locomotive Company. When first built these locomotives were remarkable for their large boilers, which were, at that time, the longest ever constructed by the American Locomotive Company. The length between the tube sheets is 24ft., and there are 270 tubes, 2¼in. diameter, and 60 5½in. flues for the type A superheater. A combustion chamber 69in. long is fitted and also a Gaines wall, the total fire-box heating surface with the combustion chamber is 473 square feet and the grate area is 113 square feet. The boiler is of the straight top type, with a round top fire-box and radial staying, and the total length from the front of the smoke-box ring to the end of the foundation ring at the hind end is 56ft. 11½in. The barrel is in four courses, two cylindrical next the smoke-box, followed by a short tapered section next the dome course, which, together with the last, is cylindrical. The smoke-box contains two blast-pipes, one in front of the other; these exhaust into a double chimney, each section of which has a petticoat extending well into the smoke-box. One blast-pipe exhausts the steam from the rear power unit, and the other from the leading unit. The feed water heater, of the Elesco pattern, is mounted as usual on the top of the smoke-box and the brake compressors on the front. An unusual feature is the provision of a slipping throttle which consists of chokes which take the form of butterfly valves fitted in the rear unit exhaust pipes, and in the steam pipes for the leading engine. These valves are operated by means of compressed air cylinders, and offer a very quick means of checking slipping. The steam distribution is effected by 12in. piston valves, operated by Walschaerts' gear controlled by a power reversing gear.

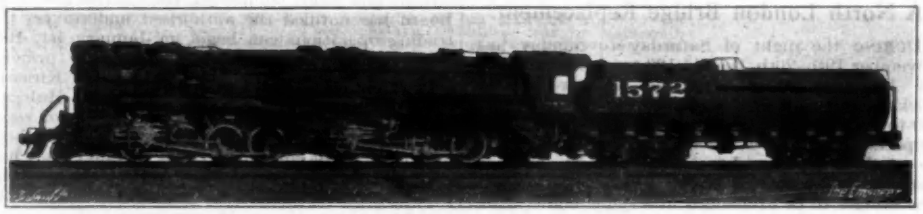


Fig. 2—Chesapeake and Ohio Railway—High-Pressure Articulated Locomotive

The leading engine has a truck with 30in. wheels, and the driving axle journals are 11½in. by 13in., the others being 11 by 13. The trailing truck has 42in. wheels, and the coupled wheel base of each engine is the same, viz., 15ft. 9in. The total weight available for adhesion is 491,840 lb., giving an adhesive factor of 4·75.

Firing is done by a standard stoker. The tenders are of the Vanderbilt design, and those applied to the Baldwin engines run on twelve wheels, and carry 16,000 U.S. gallons of water, and 20 tons (2240 lb.) of fuel. The weight full is 299,070 lb., or 133·3 tons (2240 lb.). The total locomotive weight is 387 tons (2240 lb.).

During 1929 tests carried out with one of these engines working coal trains between Russell, Ky., and Toledo, Ohio, gave the following results, which are of interest, as showing the capacity of these large locomotives. The distance between these two points is 236 miles, and between Columbus and Toledo pusher assistance was provided over a 14-mile gradient, averaging 0·4 per cent.:—

Train load	144 cars
Number loaded	140 ,,
,, unloaded	4 cars
Actual tonnage	10,724
Average speed	20·51 m.p.h.
Number of stops	13
Total coal as fired	87,550 lb.
,, water	576,000 lb.
Coal per 1000 gross ton-miles	35·41 lb.
Coal per sq. ft. grate per hour	81·30 lb.
Evaporation water per lb. of coal	6·64 lb.
Coal per D.B.H.P. per hour	3·52 lb.
Water per D.B.H.P. per hour	23·32 lb.
Average D.B.H.P.	2,632
,, boiler pressure, lb. per sq. in.	204
,, steam chest pressure, lb. per sq.	173
,, back pressure, lb. per sq. in.	8·2
,, B.Th.U. per lb. coal as fired	13,834
Max. draw-bar pull, starting	105,000 lb.
Average draw-bar pull	46,882 lb.

The train weights given are in short tons, and ton-mile consumptions are based on these figures.

* No. I. appeared November 18th.

Another example of the Mallet design having four simple-expansion cylinders is found in some large locomotives built for the Great Northern by Baldwins. The illustration, Fig. 3, shows that these have Belpaire fire-boxes, as against the much more usual round-top radial stayed type. These engines of the 2–8–8–2 classification secure a high tractive effort, 127,500 lb., by the use of four 28 by 32 cylinders, in conjunction with 63in. drivers, and a boiler steam pressure of 210 lb. per square inch.

The fire-box and combustion chamber furnish in all 432 square feet of heating surface, and the grate area is 108 square feet. The superheater is of the A type, housed in 68 5½in. flues, and there are 310 2¼in. tubes, the length being 24ft.

The fuel used is oil. The steam is distributed by 14in. piston valves, actuated by Walschaerts' motion, and set to give a full gear cut-off of 65 per cent. The main steam pipe in the boiler runs forward from the dome to the header as usual, and thence two pipes extend to a second header in the bottom of the smoke-box, from which steam is taken to the rear engines by two outside pipes, one on either side, and to the front unit by a centrally located pipe. The exhaust from the front cylinders is taken to the blast-pipe by a flexible pipe placed on the centre line, while that from the rear cylinders is conveyed by a pipe on the left-hand side, terminating in an annular opening surrounding the exhaust nozzle from the leading engines. This piping has been effective in equalising the pressures in the leading and hind steam chests, as shown by diagrams taken at 14 miles per hour, when front and hind engines developed 1569 I.H.P. and 1578 I.H.P. respectively, with a boiler pressure of 204 lb. per square inch.

The cylinders are interchangeable between front and back units, as are also the piston crossheads and connecting-rods, and the corresponding crank pins, wheels, and axles.

The tenders of the Vanderbilt type run on twelve wheels, and have space for 17,000 U.S. gallons of water and 5933 gallons of oil. The engine weight is 264·2 long tons and with the tender 402 long tons.

The engines successfully handle 4500-ton trains on 0·8 per cent. gradients over the Rocky Mountains in the summer season.

During 1929 a larger design of the 2–8–8–4 type was introduced. In it the tractive effort has been increased to 146,000 lb., the combined heating surface to 11,384 square feet, and the engine weight to 630,750 lb., or 284 long tons. The four-wheeled trailing truck permits of a larger fire-box, having 481 square feet of heating surface, and the equivalent of 126 square feet of grate. The larger heating surfaces are obtained chiefly by the employment of a superheater, which provides no less than 3515 square feet of surface, or 30·8 per cent., of the total combined surface. The cylinders and drivers have the same dimensions as in the previous design, and oil fuel is used.

In 1928 the American Locomotive Company built the largest locomotive in the world. It is in service on the Northern Pacific system, and weighs with its tender in working order no less than 1,116,000 lb., say, 498 long tons—see Fig. 4. The principal reason for the great size and weight of this design is the desire of the railway to use a very low grade of Montana fuel from an open mine owned by the company. As received, the coal contains some 30 per cent. moisture, and as fired the heat value is not more than 7000 B.Th.U. To generate steam for four 26 by 32 cylinders, a very large boiler was therefore necessary, having adequate grate surface. The boiler is the largest of the locomotive type ever constructed. It is 63ft. 8¾in. long overall, and the length of the fire-box and combustion chamber is 28ft. 6⅝in.

The grate area is 182 square feet, and the total heating surface evaporating and superheating reaches the high total of 10,892 square feet. Five Nicholson syphons are applied, three in the fire-box and two in the combustion chamber. The working steam pressure is 250 lb. per square inch. The superheater is housed in 280 3½in. flues, and, in addition, there are 92 2¼in. tubes, the length over tube sheets being 22ft. The largest diameter of the barrel is 110¼in. outside; the rear section and the dimensions inside the fire-box sheets are approximately 22ft. by 9ft. 6in.

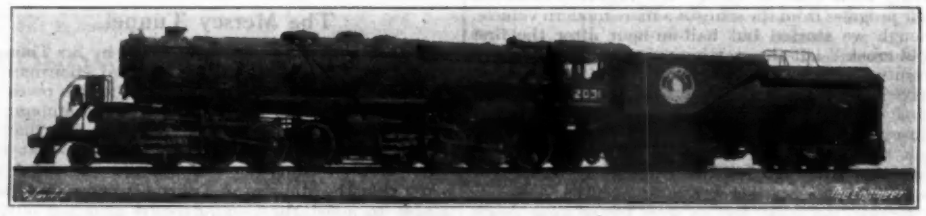


Fig. 3—U.S. Great Northern Railway—Simple Expansion Mallet Locomotive

A feed-water heater of the Coffin type is fitted in the arch of the smoke-box ahead of the chimney, and the mechanical stoker is capable of firing 40,000 lb. of coal (17¾ tons) per hour.

It may be mentioned that the feed heater is said to have the largest heating surface of any so far applied to a locomotive. The boiler feed is supplied by two standard Coffin centrifugal pumps, having a combined capacity of 120,000 lb. of water per hour. The pumps are separately controlled. Additional feed is provided by two injectors of 104,000 lb. per hour capacity. The boiler is designed to evaporate 120,000 lb. of water per hour.

Each power unit is of the eight-coupled type, having 63in. wheels, a single-axle truck supports the leading end, and the back end has a four-wheeled truck equipped with a booster. The total wheel base, engine only, is 66ft. 8in., and the length from the face of the front coupler to the rear buffer connection with the tender is 80ft. 5½in. Piston valves, 14in. diameter, and having a 7½in. travel, distribute the steam, and the full gear cut-off is 70 per cent. The superheater header is fitted with a multiple valve throttle, worked by outside connections with the cab, and manipulated by a power-operating gear. The Walschaerts' motion is, as usual, power controlled. The cylinder castings are of steel, and are interchangeable, and each pair complete with valve chests and cross connections, is in one piece. The main journals are 12½in. by 14in. The tractive effort of the main engines is 140,000 lb., giving with 553,000 lb. on the sixteen drivers a factor of 3·95. A Franklin booster, operating at 50 per cent. cut-off, provides a further 13,400 lb. tractive effort, making the total 153,400 lb. During 1930 a further lot of these engines was built by the Baldwin Locomotive Works.

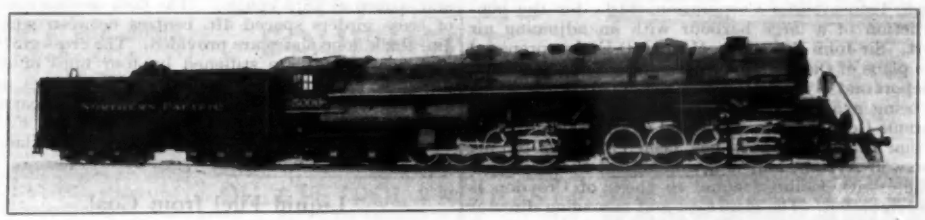


Fig. 4—Northern Pacific Railway—498 Long Ton Mallet Locomotive

To provide for the required quantities of fuel and water, ample tender capacity is required, and the tender, carried on twelve 37in. wheels, with 7in. by 14in. journals, has fuel space for 27 short tons and 21,200 U.S. gallons of water. The weight full is 401,000 lb., or 179 long tons.

Some very large Mallet engines have recently been delivered by the Baldwin Locomotive Works to the Western Pacific, and one is shown by Fig. 5. The engines were designed more particularly to work over a long rising gradient of 1 in 100, extending for more than 100 miles between Oroville and Portola on the line from Oakland, Cal., and Salt Lake City, Utah. The trains to be handled are made up to about seventy

cars and weigh 3390 tons. To meet this requirement, an engine of the 2–8–8–2 wheel arrangement was designed. It has four simple cylinders, 26 by 32, and coupled wheels 63in., which, with steam at 235 lb. pressure, give a rated tractive effort of 137,000 lb. increased when required to 150,900 lb., when a booster, applied to the trailing truck is cut in.

The boiler is of ample size, comparing well with other engines of about the same power. The heating surface totals 9032 square feet, including the superheater, furnishing 2152 square feet. Oil fuel is used, so that in reality there is no grate, but the horizontal section of the fire-box at grate level is equal to 145 square feet. There are 75 flues, 5½in. diameter, and tubes to the number of 272 of 2¼in. diameter.

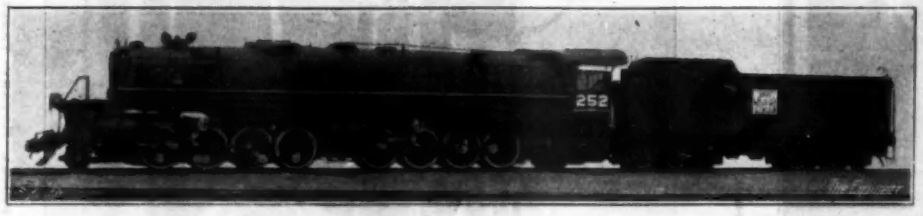


FIG. 5—WESTERN PACIFIC RAILWAY—MALLET TYPE LOCOMOTIVE

Walschaerts' motion and piston valves distribute the steam.

The maximum valve travel is 7½in., and the full gear cut-off 85 per cent. A power-reversing gear is used, and the teeth in the reverse lever quadrant are blanked off between full gear and a position corresponding to 70 per cent. admission. The arrangement is such that the booster cuts out when the rate of cut-off in the main cylinders is reduced to 70 per cent.; thus when the main engines are working alone, the maximum rate of cut-off is not more than 70 per cent. of the stroke.

A smoke-box throttle is used, the feed-water heater is placed in a recess in the top of the smoke-box, and the feed pump and air compressors are mounted on

FIG. 6—BALTIMORE AND OHIO RAILWAY—EXPERIMENTAL MALLET LOCOMOTIVE

the smoke-box front. Other fittings include five Nicholson syphons, two in the combustion chamber and three in the fire-box, a mechanical lubricator for the main engine cylinders and valves, and one of the hydrostatic type for the feed pump, compressors, and booster.

Of the six engines built, two are fitted with Worthington feed-water heaters and four with Elesco closed heaters.

The arrangement shown fitted to the chimney is a mechanically operated hooded deflector for use when passing through tunnels.

Twelve-wheeled tenders are fitted; they are of the rectangular water bottom type, having cast steel frames. The wheels are 36in. diameter, journals

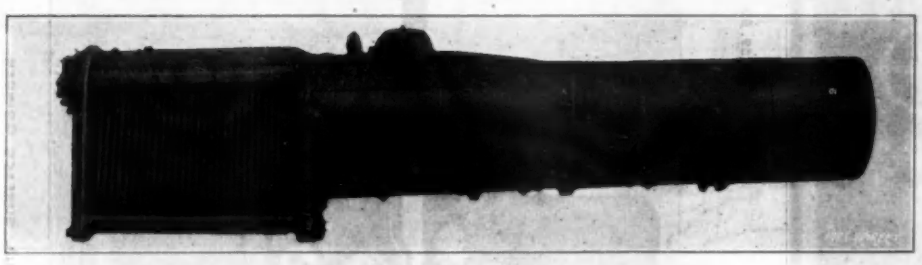


FIG. 7—BOILER WITH EMERSON WATER-TUBE FIRE-BOX

7in. by 14in. The tank capacity is 22,000 U.S. gallons, and the oil fuel carried is 6000 U.S. gallons. The total locomotive weight in working order is 1,073,350 lb., or 480 long tons, and of this, the engine alone accounts for 297 tons.

This brief review of the modern development of articulated Mallet engine in the United States will conclude with a reference to two interesting locomotives of this type for the Baltimore and Ohio, for which road the first compound Mallet was built in 1904. The engine illustrated by Fig. 6 is one of two constructed experimentally by the Baldwin Locomotive Works early in 1931. The general design and specifications were prepared by Mr. G. H. Emerson, Superintendent of Motive Power, to whom the writer is indebted for the photograph reproduced and other information. The two engines are alike, except that the one illustrated is equipped with a water-tube fire-box designed by Mr. Emerson.

The engines are remarkable for the large size of their coupled wheels, which are 70in. diameter. They were built to handle fast heavy freight trains over sections of the line having severe bridge restrictions, making it impossible to employ sufficiently powerful non-articulated designs.

In building these engines every effort was made to cut down weight and the boilers are of nickel steel, cylinders of cast steel, whilst the axles are hollow bored, crank pins are hollow bored, and single bar crosshead guides are employed. Furthermore, all cross brace members are welded to the main side frames. The tenders are also specially light in design, and when loaded with 18,000 gallons of water and 20 tons (40,000 lb.) of fuel, weigh complete 273,000 lb., or 123 long tons. This is believed to be a record, as the coal and water per 1 lb. weight of tender is 2·16 lb. The cylinders are 23 by 30, and the working steam pressure is 250 lb. per square inch. These dimensions with the 70in. drivers give a tractive effort, estimated, of 90,000 lb. The piston valves driven by a light design of Walschaerts' gear are arranged for a full gear cut-off of 70 per cent.; they have a maximum travel of 7in., a lap of 1¼in., $\frac{1}{16}$ lead, and are set line and line on the exhaust edges. The main journals are 12in. by 13in., and those for the other coupled axles are 10½in. by 13in. For the front truck, which has 36in. wheels, they are 6½in. by 12in., and for the rear truck, having 46in. wheels, they are 9in. by 16in. The 2–6–6–2 wheel arrangement is unusual for a Mallet design. The engine has a very neat appearance and the straight running boards and well-arranged piping assist materially in producing a good-looking locomotive. Chief interest will, however, be centred in the design and construction of the Emerson fire-box (Fig. 7), as fitted to a Pacific type boiler will, together with the following delineation, make this arrangement clear.

THE EMERSON FIRE-BOX.

In the construction of the Emerson water-tube fire-box a single drum of large diameter is employed, extending the entire length of the box. At the front end the drum, which for the engine under notice has an inside diameter of 40in., enters the upper part of the boiler barrel, and at the hind end passes through two parallel plates forming the rear water leg and back head. At the point where the drum joins the boiler, it is fixed by an inturned flange in the rear tube plate and secured to the shell by a special hip plate. The plates forming the rear water leg are flanged to receive the drum, which has a series of ports cut in it to make communication with the space within the water leg. The rear end of the drum is closed by a dished plate fitted with a manhole. At the bottom of the fire-box and about level with the grate two rectangular headers are arranged, one on each side. These headers of seamless steel forgings are 5½in. by 7½in. and connect the front and rear water legs, the plates of which are flanged for this purpose, and at the top and running along the sides of the drum two similar headers are fixed. The upper headers do not communicate with the back head, or the boiler barrel, but have closed ends. A series of nipple connections, 4in. outside diameter, join the top headers with the drum. The water tubes, 190 in number, and of 2¼in. diameter outside, extend between the upper and lower rectangular headers, there being 95 on each side of the box, arranged in two rows, 47 tubes inside next the fire, and 48 outside. The tubes are rolled into the headers, which are provided with suitable plugs opposite the ends of the tubes. The plugs in the bottom headers are for construction only, whilst those in the upper side of the top headers are fitted with coarse threads and are removable for washing-out purposes.

The engine illustrated (Fig. 6) has a fire-box of this type, providing 783 square feet of heating surface in the water tubes and back and front heads, or a total of 866 square feet with the arch tubes. The grate area is 92 square feet. The arch is carried by the arch tubes, as usual, and at the front a low wall is built up 50in. from the tube plate, which joins the arch, thus forming a combustion space ahead of the grate. The boiler has a diameter of 89⅜in. inside and there are 260 tubes, 2¼in. diameter, and fifty-two flues, 5½in. The length over tube plates is 25ft. Firing is by means of a Lower mechanical stoker, and the feed water supply is by an exhaust steam injector, and one of the ordinary type is also fitted.

Compared with the usual stay bolt fire-box, the water-tube construction provides a substantial increase in direct heating surface without increasing the weight, and its use also eliminates the usual stays for the support of all crown, combustion chamber, and side sheets. No flexible stays are required, only ordinary short hollow stays being employed for the front and back water spaces.

The following statement gives a summary of the average results obtained during three test runs with one of these Mallet engines, No. 7400, fitted with the Emerson fire-box.

TABLE I.—*Results of Dynamometer Tests, Keyser, W. Va. and Brunswick Md.*

Number of runs	3
Season of year	Winter
Train consist:	
Load cars, number	96
Other cars, number	1
Total cars, number	97
Actual tons (2000 lb.)	8245
Total time on route	5 h. 49·6 min.
Net „ „	5 h. 13·2 min.
Average speed, m.p.h.	20·91
Total coal as fired	31,500 lb.
„ water evaporated	27,204 galls.
Coal as fired per 1000 G.T.M.	35·14 lb.
„ „ „ sq. ft. of grate per hour	86·82 lb.
Evaporation water per lb. of coal	7·20 lb.
Coal per D.B.H.P. hour	3·14 lb.
Water per D.B.H.P. hour	22·59 lb.
Average D.B.H.P.	2,546
„ draw-bar pull	47,951 lb.
„ boiler pressure, lb. per sq. in.	246·2
Average steam chest pressure, lb. per sq. in.	216·3
Average back pressure, lb. per sq. in.	3·7
„ cut-off, per cent.	42·8
Maximum steam temperature, deg. Fah.	610
Average B.Th.U. per lb. coal as fired	12,994
Overall thermal efficiency based on work on draw-bar, per cent.	6·25

NOTE.—The difference between the boiler and steam chest pressures is in part due to the regulator not being always fully open during the different runs.

Precision Grinding Machines.

No. X.*

SURFACE GRINDING MACHINES.

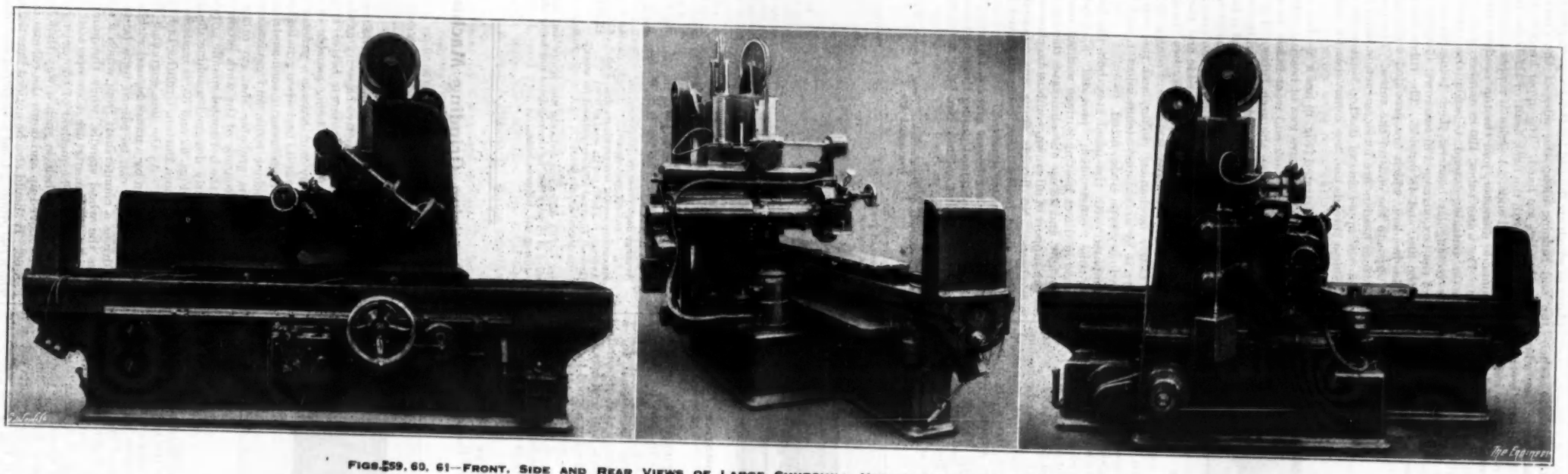
HORIZONTAL SPINDLE.

ALTHOUGH the horizontal spindle grinding machine has not so high a productive capacity as the vertical spindle type, it is very much better adapted for certain classes of work, being capable of a higher degree of accuracy and having a greater range of application. It is at its best when grinding parts long in proportion to their breadth, such as straight-edges, the beds of machine tools, and gauges used in the works, and it is probable that no other machine influences the accuracy of the work produced in any shop more than the horizontal spindle grinder.

The very neatly designed machine illustrated by the engravings, Figs. 62 and 65, is made by K. Jung, of Berlin, for whom Burton, Griffiths, Ltd., are agents in this country. As the line engraving shows, the machine is driven by a motor housed within the base, to which access can be gained by a large door. A belt drives a countershaft from which a second belt drives the wheel spindle, while the pumps for the hydraulic movements are also operated from this countershaft. The method of connecting the wheel spindle driving belt in such a way that the spindle may be moved up and down the column is shown in Fig. 66. It should also be noticed that the slide upon which the grinding head is mounted is protected from the entrance of dust and dirt by a cap and expanding

* No. IX. appeared November 18th.

HORIZONTAL SPINDLE SURFACE GRINDING MACHINES



FIGS. 59, 60, 61—FRONT, SIDE AND REAR VIEWS OF LARGE CHURCHILL HORIZONTAL SPINDLE SURFACE GRINDING MACHINE

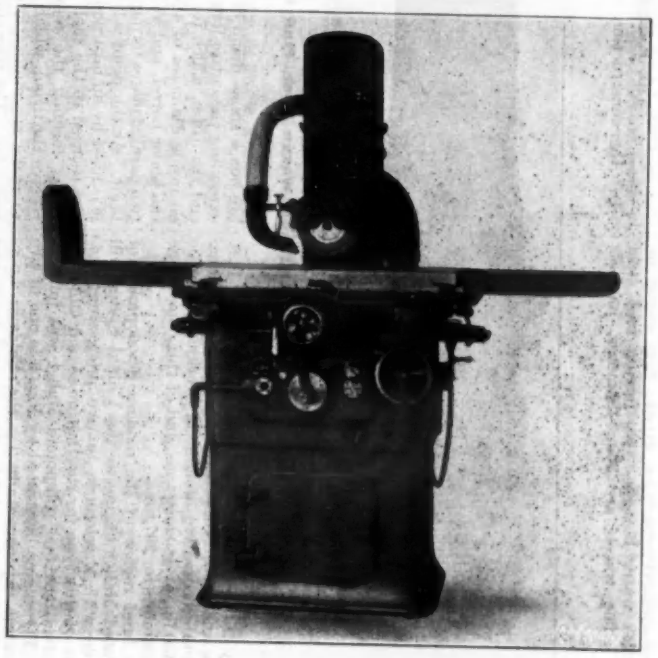


FIG. 62—JUNG SMALL SURFACE GRINDER

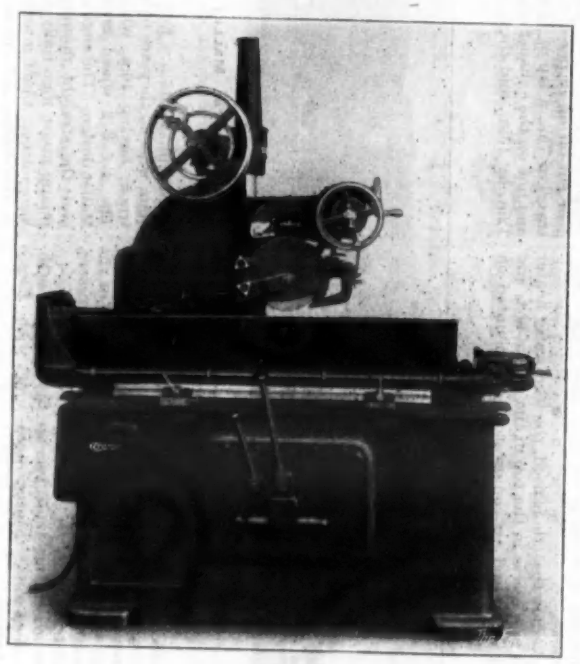


FIG. 63—NORTON SURFACE GRINDER

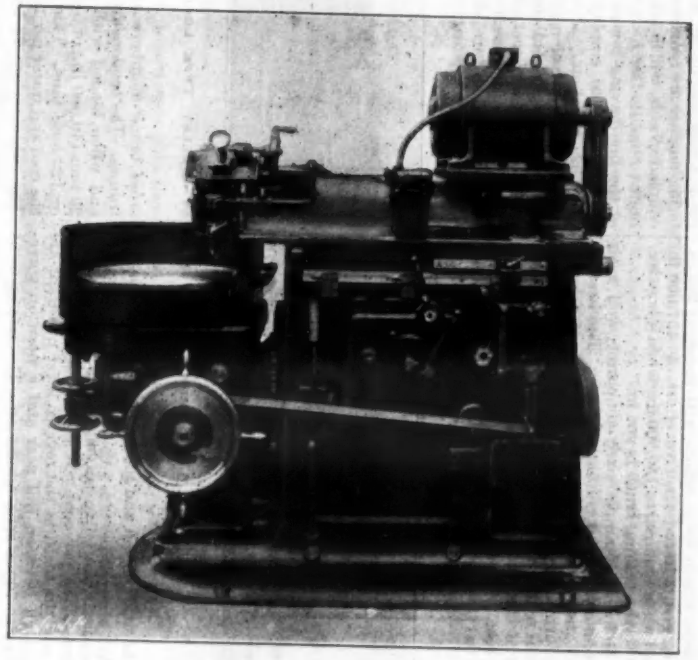


FIG. 64—CHURCHILL ROTARY TABLE SURFACE GRINDER

bellows. The grinding head itself is illustrated in more detail by the line engraving, Fig. 67. In order to dispense with the undesirable tapping of ring nuts the bearings are adjusted by a worm and wheel mechanism, so that the alteration can be made very delicately and easily. Once set, any possibility of the bearing working out of adjustment is precluded. The pull of the belt on the spindle is in an upward direction, as is also the thrust on the wheel, so that the spindle is always kept in close contact with the top half of the bearing, and any chance of vibration minimised. For trueing the wheel a small diamond holder is supplied. In

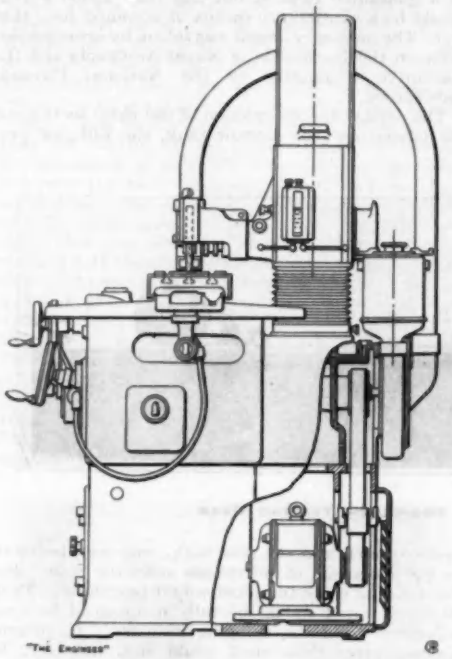


FIG. 65—JUNG SURFACE GRINDER

use, it is clamped to the table and traversed across the face of the wheel.

The work table is mounted upon one flat and one V slide, and its reciprocation is operated and controlled hydraulically from a single lever, and may be at any rate from nil to 16ft. per minute. The feed is obtained by cross sliding the table upon V slides the full width of the base apart. This movement may be controlled, but not operated, hydraulically. It is claimed that the flexibility of the machine is such that rough and finish grinding may be carried out with the same wheel by varying the table feed. All the slides are protected from the entry of dust and

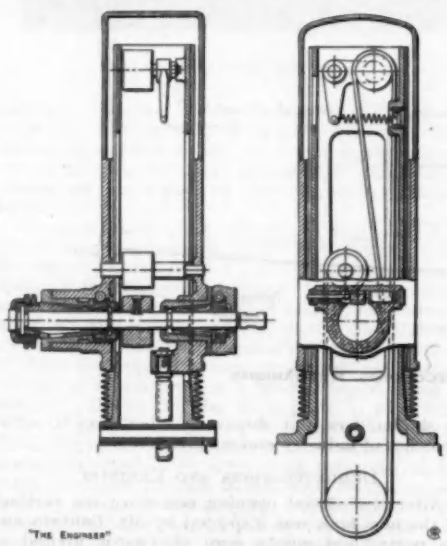


FIG. 66—WHEEL SPINDLE DRIVE

dirt. The oil pump and other mechanisms, with the exception of the ratchet wheel and pawl for the cross traverse, are situated inside the base of the machine away from dirt and dust, and in order to keep the oil for the hydraulic operation clean all the channels are enamelled. From the piston of the hydraulic mechanism the table is driven by rack and pinion at a speed twice that of the piston. A crank disc is also operated by the hydraulic mechanism, and actuates the cross feed through a pawl engaging with a ratchet wheel mounted on the screw. Variable feeds are obtained by altering the position of the crank in the slot of the disc, and adjustable stops trip the cross feed by opening a valve and allowing the oil to run back to the main tank. This motion may also be actuated by hand.

Great care, it will be noticed, has been taken to exclude dust from any of the working or sliding parts. The comfort of the operator is also studied by the provision of an exhauster driven from the main drive countershaft and situated at the rear of the machine. In case it should be desired to place the machine in a position where the disposal of the dust would prove a difficulty, the exhauster can be arranged to deliver into a simple filter consisting of a hollow cylinder with pierced walls in the annular part of which a

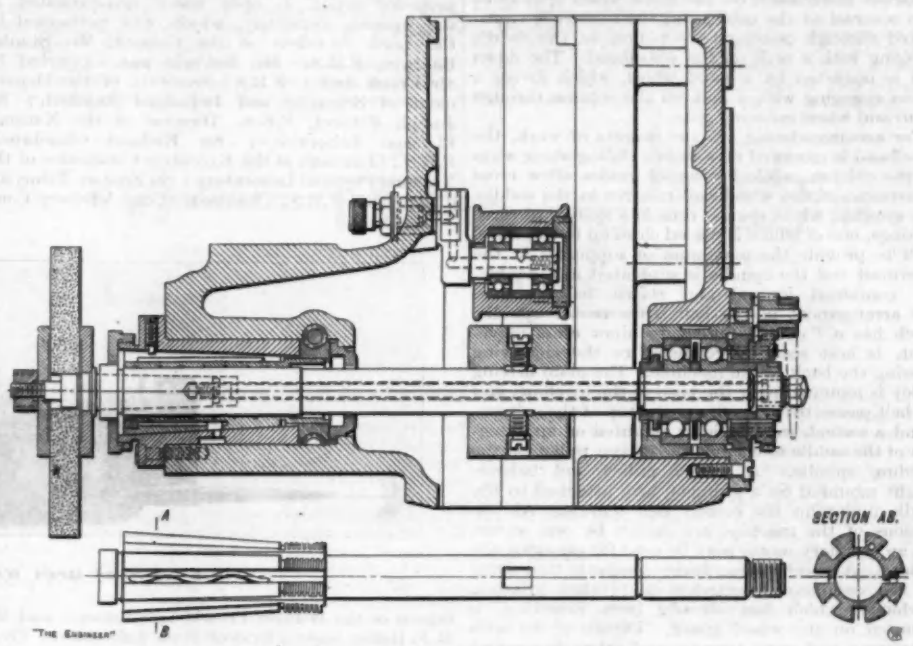


FIG. 67—GRINDING HEAD OF JUNG MACHINE

number of small copper cups, covered with a thin layer of oil, are packed. The whole affair is carried in a housing, and it is only necessary to clean it once a week.

The capacity of the machine and some of the more important dimensions are given in the following table:

Grinding length	27½in. (700 mm.)
Grinding width	7¾in. (200 mm.)
Working surface of table	27½in. × 7¾in. (700 mm. × 200 mm.)
Transverse motion of table	8¾in. (220 mm.)
Maximum distance between table surface and spindle centre	13¾in. (350 mm.)
Maximum speed of the longitudinal travel of the table, per minute	33ft. (10 m.)
R.p.m. of the spindle	2800
Maximum size of the wheel—	
Diameter	7¾in. (200 mm.)
Width	¾in. (20 mm.)
Automatic cross feed of table	0·005in. ÷ 0·07in. (0·12 mm. ÷ 1·8 mm.)
Width of spindle belt	1¾in. (45 mm.)
Horse-power, about	2
Requisite floor space	98in. × 49in. (2·5 m. × 1·25 m.)

AN AMERICAN EXAMPLE.

A machine with a slightly greater capacity made by the Norton Company of America, for which Alfred Herbert, Ltd., are agents in this country, is illustrated by the tone engraving, Fig. 63. It will accommodate work 10in. wide, 12in. high under a full-size wheel, and 24in. long. If a magnetic chuck is used the limitation of height is 9½in. The driving motor is housed in the base and delivers power by belt directly to the spindle pulley, *vid* a set of idlers, while a second belt drives the oil pump for the hydraulic mechanism and the lubricant pump. As is usual, the table is mounted on one V and one flat slide, oiled by means of rollers set in oil pockets in the ways. By manipulation of the throttle valve lever, it is possible to reciprocate the table at any desired speed up to 60ft. per minute, since the operation is hydraulic. By making the operating cylinder of brass and using copper piping, it is claimed that a minimum resistance is offered to the passage of the oil, so that a steady, smooth, and positive motion of the table is ensured. The mechanism is all enclosed within the base. Adjustable dogs on the front of the table engaging with a hand lever bring about the reversal. The wheelhead is carried on the column, which is securely bolted to the base of the machine. Besides the vertical adjustment on dove-tailed ways on the column, the cross feed is obtained by mounting the wheelhead on a cross slide. Although an automatic cross feed can be fitted, the machine is usually constructed only with hand adjustment. The line engraving, Fig. 68, shows the wheel spindle. It is mounted in ball bearings and equipped with a positive end thrust, so that the grinding of formed surfaces can be undertaken. The wheel is 10in. in diameter by 3in wide. A large conveniently situated hand wheel controls the vertical feed of the wheel, and allows the setting to be altered by steps of 0·00025in., while if it be desired to duplicate wheel settings, a positive stop is provided.

AN ENGLISH MACHINE.

A still larger machine, made by the Churchill Machine Tool Company, Ltd., of Manchester, is illustrated by Figs. 59, 60, and 61. It is an open-sided design, like the others, will take work 12in. wide by 20in high, and is made in three sizes, capable of grinding lengths of 47in., 60in., and 72in. respectively, that illustrated being the longest. A magnetic

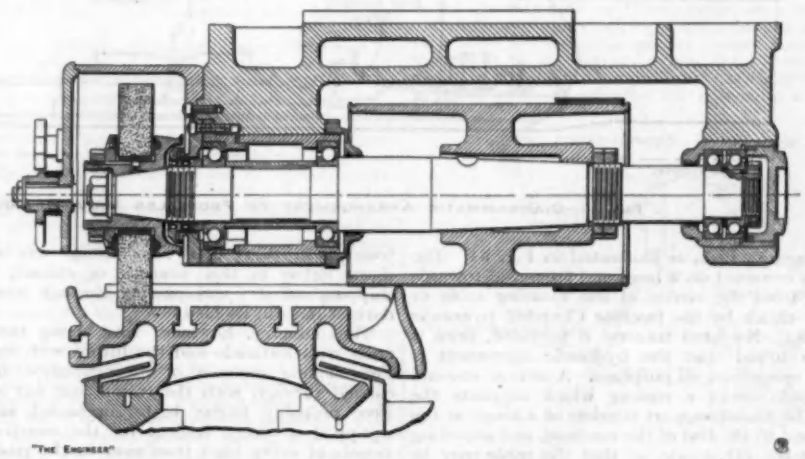


FIG. 68—WHEEL SPINDLE OF NORTON MACHINE

chuck is shown mounted on the table. This fitting reduces the height capacity by about 3in., when a new grinding wheel, 16in. in diameter and 2in. wide, is in place. Observation of the engraving of the front of the machine will show that the three-lever control box of the hydraulic traverse is similar to that of other types of grinders made by the same makers. The mechanism has been previously described, but it should be noted that a withdrawal plunger is fitted to the reversing lever in order to allow the table to overrun to its extreme position for the mounting,

unloading, or inspection of the work. A safety trip in the form of a dead stop prevents the table traversing too far.

So that a greater width of work than that of the wheel may be covered, the wheelhead is mounted in such a way that it can be cross traversed either by hand or automatically. The automatic motion is brought into action by the adjustable crank disc, mounted at the front of the bed, which receives its drive from a rack attached to the table. It operates a ratchet mechanism on the hand wheel spindle at each reversal of the table, and the motion is transmitted through gearing to a pinion on the saddle engaging with a rack on the wheelhead. The down feed is operated by a hand wheel, which drives a pinion engaging with a rack on the column through worm and wheel reducing gear.

For accommodating various heights of work, the wheelhead is mounted on a saddle sliding along ways on the column, while horizontal guides allow cross adjustment of the wheelhead relative to the saddle. The grinding wheel spindle runs in a system of three bearings, one of which is placed close up to the wheel itself to provide the maximum of support. At the outermost end the spindle is supported in a double-row combined journal and thrust ball bearing. The arrangement of the belt drive to the spindle, which has a "drum" pulley to allow cross movement, is best seen by reference to the engraving showing the back of the machine. The main driving pulley is mounted near the base of the machine, and the belt passes over an idler at the top of the column, round a second, smaller, idler mounted on an extension of the saddle to encircle the driven pulley on the grinding spindle. A jockey pulley and balance weight mounted on a swinging arm attached to the saddle maintains the correct belt tension. All the motions of the machine are driven by one motor, but an auxiliary motor may be used for pumping the coolant. A wheel trueing device similar to that fitted on the company's centreless and other grinding machines, which has already been described, is mounted on the wheel guard. Details of the rates of traverse and cross traverse and other dimensions are given in the following table :—

Working surface of table (ground in position)—	
Length	72in.
Width	12in.
Maximum distance from table to centre of wheel	28in.
Self-acting cross movement of grinding wheel	14in.
Diameter of grinding wheel	16in.
Width of grinding wheel	2in.
Self-acting cross movement per stroke of table	0·008in. to 0·125in.
Traverse speed range per minute	0·50ft.
H.P. of driving motor	15
Speed of driving motor	970 r.p.m.

A Rotary Table Design.

For certain purposes horizontal spindle machines, with rotary tables, have advantages. Particularly is this the case with piston rings in which a concentric finish is desirable, rather than the radial finish which a vertical spindle machine would give them. A machine of this type, made by the Churchill Machine Tool Company, Ltd., is illustrated in Fig. 64. The spindle is mounted on a head and traversed towards or away from the centre of the rotating table or magnetic chuck by the familiar Churchill hydraulic mechanism. No hand traverse is provided, since it has been found that the hydraulic movement is sensitive enough for all purposes. A slide at one end of the bed carries a casting which supports the table. The actual support consists of a hinge at the side nearest to the bed of the machine, and adjusting screws at the other side, so that the table may be rocked for the grinding of dished or convex surfaces. Three speeds of table rotation are available, and the feed is adjusted by raising the table towards the wheel, either automatically through a mechanism operated by a trip carried on the wheelhead or by hand.

(To be continued.)

The President of the Permanent Way Institution for the year 1933 will be Mr. Arthur R. Cooper, the chief engineer of the London Underground Railways. Mr. Cooper succeeds Mr. Raymond Carpmael, the chief engineer of the Great Western.

The New Tank at Teddington.

No. II. (*conclusion*).*

In last week's article we dealt principally with the lay-out and equipment of the new tank, and described the construction of the travelling carriage, referring to its mechanical and electrical equipment. In what follows we propose to deal briefly with the arrangements for the experimental investigation of screw propeller action in open water, demonstrated at the opening ceremony, which was performed by the Lord President of the Council, Mr. Stanley Baldwin, F.R.S. Mr. Baldwin was supported by Sir Frank Smith, F.R.S., Secretary of the Department of Scientific and Industrial Research; Sir Joseph Petavel, F.R.S., Director of the National Physical Laboratory; Sir Richard Glazebrook, F.R.S., Chairman of the Executive Committee of the National Physical Laboratory; Sir Eustace Tennyson d'Eyncourt, F.R.S., Chairman of the Advisory Committee of the William Froude Laboratory; and Mr. G. S. Baker, Superintendent of the Laboratory. There were present over one hundred and seventy of the leading representatives of the British shipping and shipbuilding, marine and electrical engineering, and other allied industries, as well as representatives of scientific societies, technical institutions, classification societies, and other interested bodies. Mr. Baldwin was introduced by Sir Richard Glazebrook, who recalled the early history of the tank and Sir Alfred Yarrow's generous gift of the first tank.

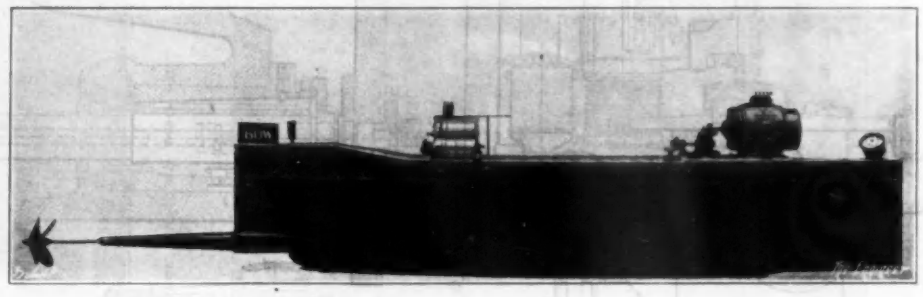


Fig. 9—View of Open Water Propeller Testing Gear

Mr. Baldwin's Speech.

In the course of his speech Mr. Baldwin, after referring to the historic work of William Froude and the foundation of the National Tank by Sir Alfred Yarrow, passed on to the events which led up to the decision of the Government in February, 1930, to provide a second tank at Teddington. Unfortunately, Mr. Baldwin continued, times were now very different from those at which the inception of the new tank took place. Very little new tonnage was being laid down either in this country or abroad, and the shipping industry was passing through some of the darkest days in its history.

The industry, however, was facing the present crisis with fortitude and the future with confidence. Far-reaching schemes of rationalisation had been carried through with the result that our shipyards were probably to-day better organised and better equipped in every respect for the construction of vessels of every kind than ever in the past. That, however, as the foremost leaders in the industry recognised, was not enough. It was necessary that the design of the ships built by British yards, when the new orders began to come with reviving trade, should be better than those which our rivals could offer. Although tank research was entirely of British origin, it had been adopted enthusiastically abroad, and it was only through the more active prosecution of research in this country that we should in the future be able to outstrip our rivals. The acquirement of new knowledge during the present period of stagnation would be an all-important factor in accelerating the recovery of the British shipping and shipbuilding industries. In carrying out the necessary research work no small part would be played by the three sections of this Laboratory—the Yarrow tank, the new tank, and the propeller tunnel now under construction as a result of the generous gift of £5000 made early in the year by Sir James Lithgow.

But research work cost money and a word had to be said on the financial aspects. In his original offer Sir Alfred Yarrow very properly laid down the condition that sufficient money was to be provided for operating the tank efficiently over a period of not less than ten years and indicated that the formation of a guarantee fund of not less than £2000 a year would be a satisfactory means of accomplishing that end. The necessary action was taken, by arrangement between the Institution of Naval Architects and the Executive Committee of the National Physical Laboratory.

The capital for the erection of the three sections of the laboratory (the Yarrow tank, the Lithgow propeller tunnel, and the new tank) had been provided by the generosity of individuals or by the State. For the running costs the ideal would be that the Tank Research Fund should be fully maintained by contributions from the shipping industry. In present circumstances that ideal could not, however, be realised, and until happier times came the State was prepared to help. Experience had shown that contributions from an industry afforded the best security for that close co-operation between the scientific staff and the practical men of that industry which was essential in the conduct of research carried out for its benefit. Under present conditions it was difficult to ask the relatively small group of firms and institutions who, for the past twenty years, had been regular contributors to the research work of the tank to do more than maintain their subscriptions. It was hoped, however, that the basis of support might be widened and that there were those present who would recognise that research work which had for its object the diminishing of the cost and the increasing of the efficiency of sea transport was of importance, not only to shipbuilders and shipowners, but also to other branches of industry and commerce.

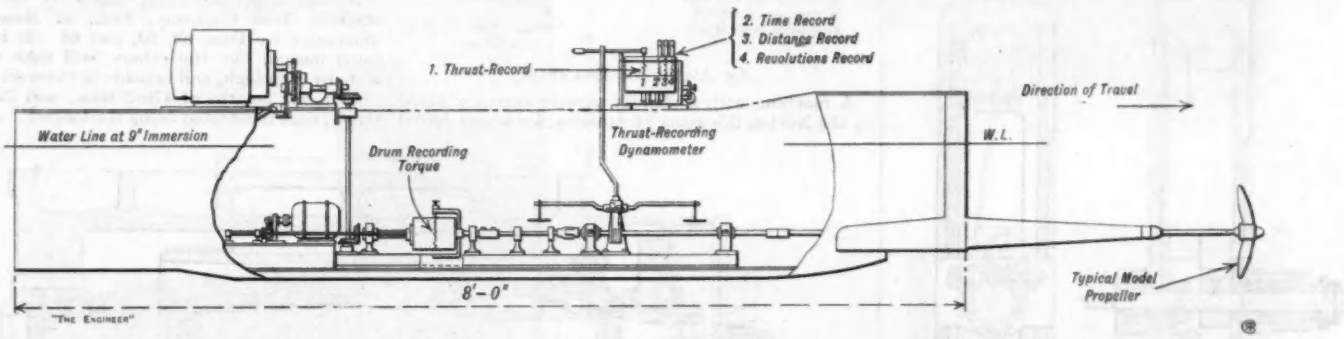


Fig. 10—Diagrammatic Arrangement of Propeller Driving and Thrust Recording Mechanisms

Demonstrations and Exhibits.

After the official opening ceremony the carriage of the new tank was inspected by Mr. Baldwin and his party, and guests were afterwards invited to make a trip and see for themselves the new equipment designed for testing propellers in open water. A photograph of the gear is reproduced in Fig. 9, and in Fig. 10 we show a diagrammatic arrangement of the body and the model screw, together with the driving and recording apparatus.

The broad principle which has been adopted is to carry the screw over 2ft. in front of the body supporting it, so that there is no interference between body and screw. The shaft carrying the propeller has freedom to move slightly fore and aft, so that the thrust can be measured by a dynamometer inside the supporting body.

In the original Froude method of testing a propeller a correction of the thrust representing the resistance of the carrying frame had to be made, but with the new apparatus this uncertain correction has been eliminated. The torque is measured by a trans-

* No. I. appeared November 18th.

mission dynamometer of the type which has now been the standard instrument used at the tank for several years. Torsion is applied by the driving motor through a long spiral spring contained within a drum. The spring is fixed to the drum at one end, and at the other end carries a pencil which records the extension of the spring on a paper secured to the drum. Time, distance, and revolutions are recorded by magnet pens in the usual way. Screws up to 14in. diameter can be tested fully immersed, at all speeds up to some 14ft. per second. The particular screw demonstrated under test for Mr. Baldwin was one of the "B" series, whose results were given in the paper at the Institution of Naval Architects last spring, read by Mr. G. S. Baker and Mr. A. W. Riddle, on "Screw Propellers of Varying Blade Section in Open Water." In the course of our inspection of the carriage we were able to examine the speed control gear, both on the carriage itself and the control desk arranged at the side of the waterway near the electric control room. A view of the desk is reproduced in Fig. 11. This photograph clearly indicates the hand wheels for coarse and fine speed control, and the ammeter and voltmeter by means of which the speed is controlled and kept constant over the period of the run. The ammeter is marked with the slipping torque, thus giving a definite indication when slipping is liable to occur, thereby avoiding possible damage to the rails. The voltmeter is calibrated in speed, and allows by means of the fine adjustment a very close speed regulation. The power necessary for driving the new carriage is obtained from a main 500-volt Chloride battery of 500 ampère-hours capacity, which drives a G.E.C. Ward-Leonard motor generator of 105 H.P./70 kW. The generator of this machine is excited from a separate 110-volt Chloride battery through a potentio-

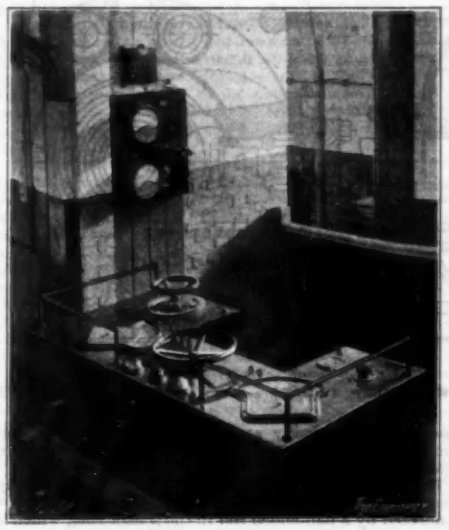


FIG. 11—THE CONTROL DESK

meter, so that the voltage it supplies can be finely controlled over the range from 10 to 225 volts. This voltage is applied to the armatures of two motors on the carriage, which are permanently connected in parallel and are separately excited from the 110-volt battery.

The speed control is interlocked in such a way that the carriage motors cannot be put on to the line unless the speed control is at its zero position, and any failure in the excitation supply to the carriage motors automatically cuts off the current. As already described, the carriage is fitted with a Westinghouse air brake, and also with rheostatic braking, and both of these are applied automatically and the current cut off by a trip lever at a predetermined point of the run. They can also be applied at any time, either from the carriage or from the speed control desk. Reversal of the direction of motion of the carriage is obtained by a reversing controller on the carriage, whose position is indicated to the control desk by means of signal lights. In addition to the tests in the new tank, steering experiments were demonstrated in the Alfred Yarrow Tank upon a self-propelled twin-screw model of a cargo liner. The rudder was automatically controlled, and the model made to yaw relative to the tank carriage, the rudder forces and the rate of yaw being automatically recorded. Later on rough water experiments with a high-speed cross-Channel type model were also demonstrated. The exhibits on view in the laboratory included a model of a ship equipped with complete apparatus for measuring and recording the efficiency and revolutions of propellers; while there was also on view a complete series of twenty-seven model screws which have been tested in the course of research work on blade shape and contour. Considerable interest was shown in the plans of the new propeller testing tunnel, presented to the Laboratory by Sir James Lithgow, which is now being built. After the demonstration tea was served in Bushey House, and this concluded a very interesting afternoon.

Modern Hydraulic Operation of Machine Tools.*

By H. C. TOWN, A.M.I.Mech.E.

A STUDY of modern machine tools shows that different designs are based upon factors that often vary widely. For example, the primary requirement of a machine tool may be either accurate production, rapid production, simplicity of design, or adaptation to a large range of work. It is because of these varying and related factors that machines, even of the same general type, are made in a number of different designs.

The four outstanding features which have recently characterised machine tool design are: first, the influence of the automobile industry; second, the increased use of electric motors; third, the introduction of the new cutting tools; and fourth, hydraulic operation.

The successful application of hydraulic operation of machine tools is the result of the tendency of recent years towards incorporating in the design quick power traverses and a larger range of speeds and feeds. This elaboration introduced awkward problems necessitating long shafts, changes in position and direction of driving parts, difficulties of alignment of shafts and bearings, and additional expense. While many of these drawbacks can be met by utilising variable-speed electric motors, the use of alternating current is gaining ground rapidly, so that the logical step for the designer is to incorporate a hydraulic pump or motor using oil as the transmission medium.

For driving purposes the variable-speed gear consists of two parts, namely, the hydraulic pump unit and the hydraulic motor unit, while for feeding purposes the application consists essentially of a pump and cylinder having a piston driven by oil circulated from the pump and controlled by piping and valve equipment.

The following is a brief *résumé* of some of the advantages claimed for hydraulic as compared with mechanical operation:—

(1) Greater flexibility of control, giving infinite number of speeds between zero and maximum.
(2) Quick reversal without shock.
(3) Simple and efficient control, both hand and automatic.
(4) Quiet operation, with automatic lubrication by the transmission oil.
(5) Lower power consumption which varies automatically to meet resistance.
(6) Safety ensured by relief valves.

The designs of practically all hydraulic feeds and drives have been based upon one of the two hydraulic circuits shown diagrammatically in Figs. 1 and 2. In both circuits pistons A are driven by oil delivered by the pumps B. The pressure is low if the pump meets with no resistance, while the distance the piston moves corresponds to the discharge rate of the pump, whether the resistance is high or low.

In case (1) the rate of feed is changed by varying the volume of oil delivered by the pump; in the other case the feed is controlled by opening or closing a choke valve C, causing more or less of the oil from the constant-delivery pump to be by-passed by valve D, but admitting oil to cylinder E at the rate necessary for the feed. The pumps employed are either of the gear type, delivering a constant volume at a constant pressure, generally about 250 lb. per square inch, but at a considerably higher pressure in some cases, or multiple-piston pumps, having about seven plungers giving 105 impulses per second to the transmission fluid, and delivering a variable amount of oil at approximately 1000 lb. per square inch, or a pump combining both types.

Where the slides to be traversed are not very heavy and the resistance is smooth and uniform, the gear pump is preferable on account of its low cost, but for heavier duty and high speeds the variable-delivery pump is more satisfactory. It will be noted that while the simplicity of control of ordinary hydraulic systems has been retained, the essential difference from common hydraulic practice is that no accumulator is used, and the variable-delivery pump prevents the great waste of power which occurs when using fluid at full pressure for light duty.

In regard to the general difficulties of hydraulic operation, one problem is that of keeping air out of the circuit, another is the control gear, which has to operate under severe conditions, and a third is leakage loss at high pressures. Due to leakage a tool holder fed by a pump cannot be used to chase a thread because its rate of feed is not absolutely constant. The tool will never move faster than the nominal feed rate, but higher pressures will retard the tool, and this lost traverse is never regained. This feature has an advantage under certain conditions, such as when the cutting tool meets an increased depth of metal or a hard place in a casting. Another advantage is that by means of a pressure gauge the action or condition of a cutting tool can be checked.

Hydraulic Control Valves and Pipe Connections.—The success of the hydraulic transmission of any tool is largely dependent upon the valve equipment. In some cases this may be of some standard type supplied with a pump or motor set, in similar manner to the control gear of an electric drive. Very often, however, the design of the machine necessitates some special valve design for a specific purpose. In almost all cases the valve equipment has to operate under severe conditions, modified in the case of a variable-delivery pump passing through a neutral position, but becoming extra severe with a constant-delivery gear pump dependent upon a relief valve. In this case oil under pressure must be rapidly cut off for stopping or reversing by valve mechanism alone, and any defect in design is liable to cause wiredrawing, violent stresses in the pipe line, and overheating of the transmission oil.

For machine tool work the piston type valve is proving very successful, although various types of rotary and slide valves are occasionally employed.

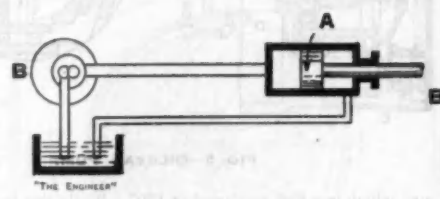


FIG. 1

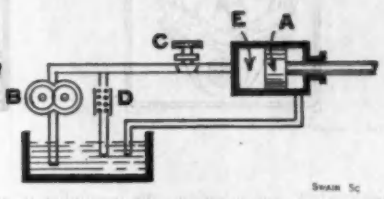


FIG. 2

VARIABLE-DELIVERY PUMPS AND HYDRAULIC MOTORS.

The Hele-Shaw Beacham Variable-speed Hydraulic Transmission.—Fig. 3 shows two sectional views of the

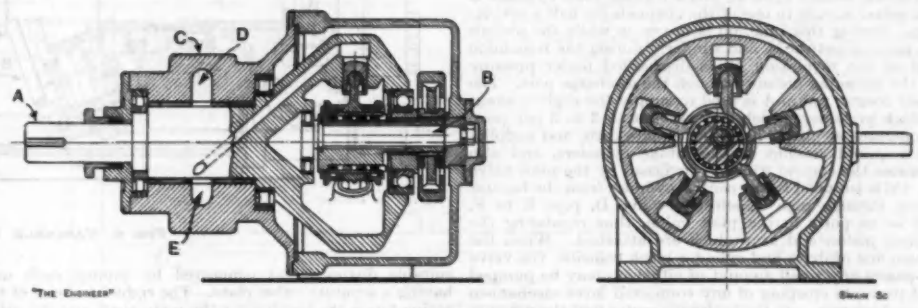


FIG. 3—VARIABLE SPEED PUMP (HELE SHAW, BEACHAM)

variable-stroke pump. The drive to the pump is by electric motor or other means coupled to the shaft A which forms part of the cylinder block and revolving valve, these three functions being obtained in the one component. The throw of the crank B is variable from a maximum at one side of the cylinder block to a similar position at the opposite side, thus passing through a no-throw position at the actual centre of rotation.

The crank is built up of two excentrics which fit one within the other, so that by turning the two relative to each other so that the respective throws cancel out, no movement of the pistons within the cylinders occurs when the cylinder block is revolving. To cause the pistons to traverse in the cylinders the excentrics are rotated about each other, and the capacity of the pump increases in proportion to the amount that the crank is offset. Reversal is obtained by moving the excentrics from a maximum in one position to a maximum in the other direction, Fig. 4 showing in diagrammatic form the lever arrangement for this purpose. Oil is admitted to and discharged from the cylinders by the fixed valve C within which the cylinder block journal revolves, the oil coming from the suction pipe D, through the holes drilled in the cylinder block to the separate cylinders. It is then forced back under pressure by the movement of the piston to the delivery pipe E, or *vice versâ*.

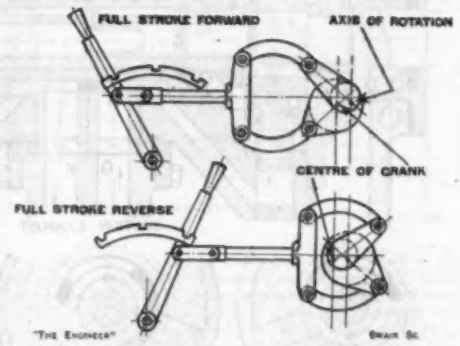


FIG. 4—STROKE CONTROL

The hydraulic motor works on the same principle as the pump, except that the crank is not made up of excentrics,

* The Institution of Mechanical Engineers.—Abstract.

but is in a fixed position. The direction of rotation is regulated by the oil entering from either pipe D or E and exhausting through the other.

The only packing employed in the pump is that for the gland, accurate fitting maintaining pressure inside the pump. The pump is run with an oil-filled case, the piston and valve leakage being conveyed directly back to the reservoir tank. This necessitates an overhead tank, which, together with a full case, minimises the possibility of air entering and eliminates a special leakage tank.

The Oilgear Hydraulic Drive.—The "Oilgear" pump, the action being shown in diagrammatic form and section views, Fig. 5, is another piston type pump, consisting of five or more radial cylinders located in a casing which forms an oil reservoir, and houses the control mechanism and rotary parts. The pistons are not fastened rigidly in the rim, but end in T-shaped crossheads, with roller bearings between the top of the crossheads and flat surfaces of the drivers. The general arrangement shows the driver and cylinder block carried on short stiff shafts, the first rotating on a dead centre and the second rotating on a movable centre which may be swung between the limits shown in the diagrams. It will be apparent that no oil will be pumped in the position shown in the centre diagram, but that in the right and left diagrams a pumping action will take place, the stroke being determined by the excentricity. The oil drawn from the supply is shown cross-sectioned, while the oil under pressure is shown blocked in. The oil is drawn from the tank and forwarded by two ports connecting with the inner end of the cylinders. When the bronze cylinder block rotates, each cylinder is connected in turn to one of the channels for half a revolution. During this time, oil is drawn in while the pistons are moving outwards, and similarly during the remaining half of the revolution oil is discharged under pressure by the incoming pistons through the discharge port. The small booster pump A is used to supply the slight leakage at high pressures, which may amount to 2 to 3 per cent. It operates at about 70 lb. per square inch, and supplies the required amount to the intake cylinders, and also operates the control which is governed by the pilot valve B. Oil is supplied to the control cylinder from the booster pump through pipe C, selective valve D, pipe E to F, and so to ports in the pilot valve, thus regulating the control piston and arm which are attached. When the centre line of drive and cylinder block coincide, the valve by-passes any small amount of oil which may be pumped and prevents creeping of any connected lever mechanism or machine ram. In the hydraulic motor unit the pressure oil from the feed port drives the pistons outward, so that the motor is driven with the necessary torque. At the end of the piston stroke, connection to the feed port ceases and the oil flows back through a return port. Thus, as before in the pump unit, the rotating motor cylinders are successively brought into connection with the feed and exhaust during one revolution. The motor speed regulation is obtained by adjustment of the piston stroke of the pump unit. The unit can be fitted with a safety device consisting of a double-acting hydraulic cylinder loaded with a safety spring and connected to the main oil line. The speed of the pump is generally 400 to 750 r.p.m., the motor speed varying from zero up to the maximum. The torque available with each ratio of power transmission depends only on the working pressure of the pump. The efficiency depends on the speed ratio and may reach 90 per cent. with a speed ratio of 4 to 3.

V.S.G. Hydraulic Variable-speed Transmission Gear.—One of the best-known hydraulic transmission gears is the arrangement shown in Fig. 6 by the Variable Speed Gear, and is a development from the "Williams-Janney," which was first produced in 1907. While this type of gear has been largely used in marine and general engineering work, the smaller sizes would certainly appear suitable for the latest developments in hydraulic transmission of machine tools, either as pumps for feed motions or as motors for driving purposes.

The illustration shows the pump unit which can be connected to a similar motor unit by a common plate, known as the valve plate, or they can be separated to any suitable distance and connected by piping, each unit having a separate valve plate. The right-hand end of the casing forms the bearing for the main shaft and the other end is closed by the valve plate A. Side covers house the bearings in which the tilting box B is mounted by its trunnions. The valve plate abuts against the cylinder barrel C, and has two semi-annular ports, one on each side of the centre line, which terminate in bosses for receiving the oil pipes. A bearing for the inner end of the main shaft is located in the centre of the plate. Any leakage of oil in the pressure system is made good automatically from the case oil through the replenishing valve D, which is of the ball non-return type, one of these being fitted to each of the two ports. Two relief valves E of the spring-loaded ball type are set at a predetermined pressure for the purpose of safeguarding the equipment against overload, the oil being short-circuited through the valve in the pressure port to the no-pressure side of the valve plate.

The function of the tilting box B is to control the stroke of the pump. The box carries Michell or roller bearings at F, against which the socket ring rotates in a plane at any desired angle, and is mounted by its trunnions in bearings located in the side covers on the casing.

Four balancing cylinders are fitted to the valve plate, in which operate rams J connected to the tilting box. The cylinders render the control smooth and easy at high speeds and pressures. Two of these cylinders are connected to each port of the valve plate, one at the top and one at the bottom. The rams are made of different diameters to an extent which is dependent upon the standard speed of revolution of the pump and the amount of lead to the valve plate ports. The cylinders, two of which are always under the full operating pressure of the

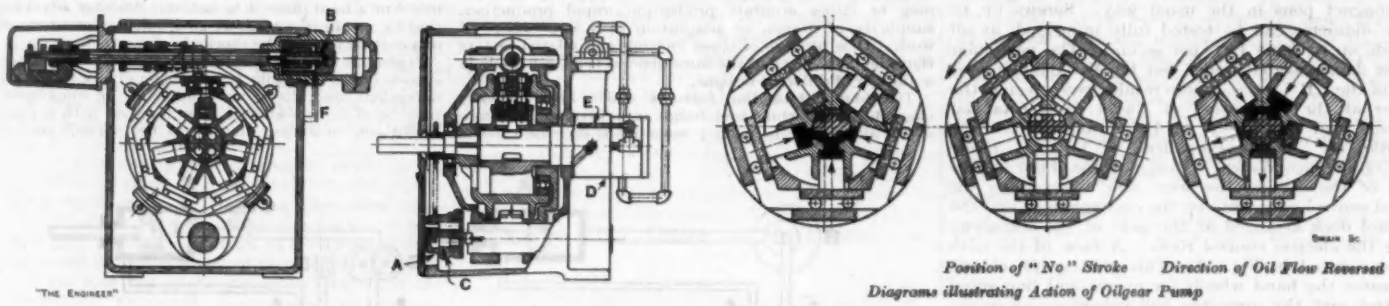


FIG. 5—OILGEAR PUMP

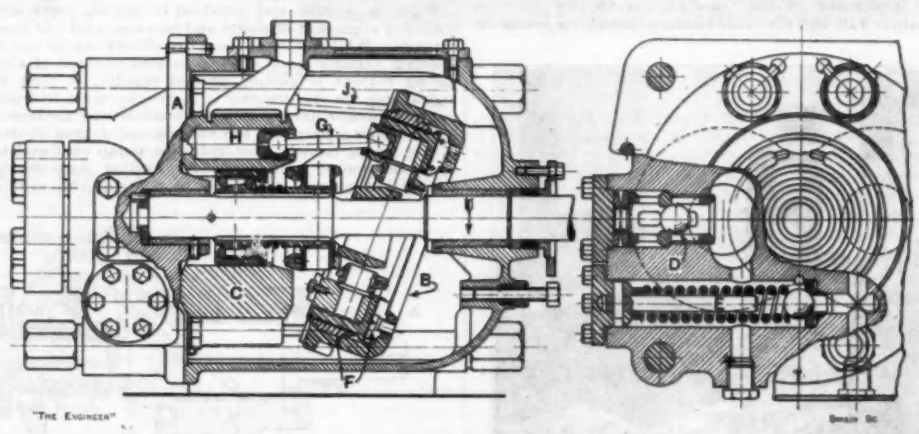
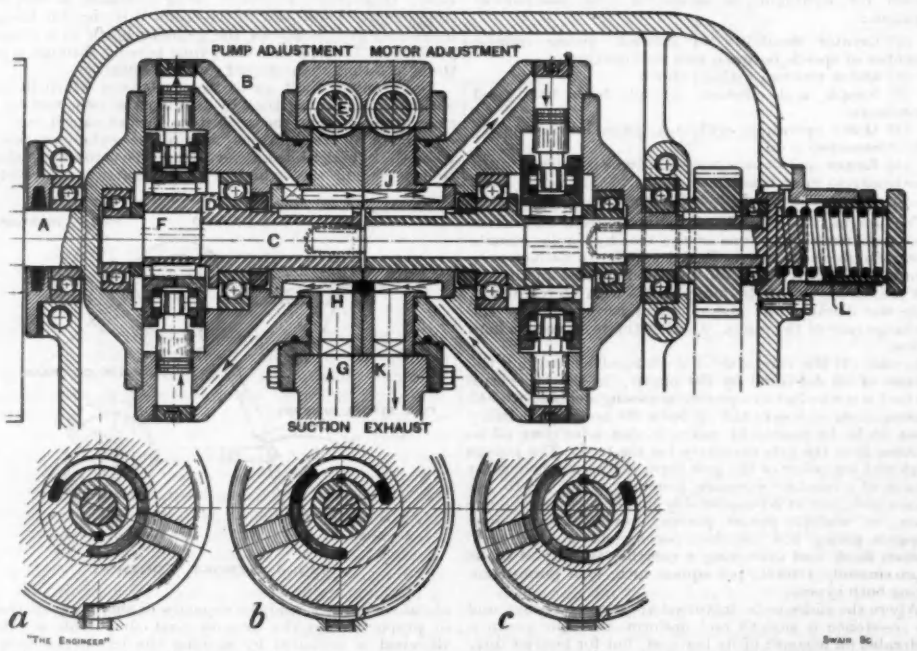


FIG. 6—VARIABLE DELIVERY PUMP (V.S.G.)



a. Pump min. stroke; Motor max. stroke. b. Pump max. stroke; Motor max. stroke. c. Pump max. stroke; Motor min. stroke.

FIG. 7—HYDRAULIC DRIVE FOR 7-INCH CENTRE S. AND S. LATHE

The cylinder barrel, which is free to move axially, contains eleven cylinders H, each fitted with a piston G connected by a ball-ended rod to the socket ring, which is, in turn, connected to the main shaft by a double universal joint. Assume for the purpose of explaining the functioning of the gear that both pump and motor, which is of similar construction to the pump, are built in one unit. The gear case is filled with oil, no air pockets exist, and if the tilting box is set perpendicular to the main shaft, it will, if rotated, carry with it the socket ring, the cylinder barrel together with the pistons and connecting-rods. The pistons will not reciprocate in the cylinders, and as there will be no delivery from the pump, the motor will remain stationary.

If the control be moved to bring the tilting block to the position shown, and the main shaft is rotated in the direction shown, the pistons as they move will be driven in towards the valve plate, expelling the oil contained in the cylinders through the cylinder ports, which are opposed to the ports in the valve plate. The motor will then commence to rotate at a speed corresponding to the amount of delivery. The pistons on the opposite side will, as they descend, be drawn away from the valve plate and their cylinders fill with oil from the valve plate port facing them. It should be noted that when a piston reaches the top or bottom position in its revolution, it makes for an instant no end movement. This corresponds with the cylinder port crossing the top or bottom lands between the two valve plate ports. The motor end is an inversion of the pump unit, the socket ring being at a fixed angle of 20 deg., the pistons making their full stroke as they pass between bottom and top positions.

The oil from the pump exerts pressure on the motor pistons facing the pressure port, and, due to the socket ring being held in the tilting box, the pistons cannot move except by rotating the socket ring in the inclined plane in which it is held, thereby converting the reciprocating motion of the pistons to rotary motion of the main shaft in an opposite direction to the pump unit.

The speed of the motor depends upon the quantity of oil delivered by the pump. Thus, if each cylinder has a capacity of 3 cubic inches, the eleven cylinders would together transfer 33 cubic inches of oil from the right-hand to the left-hand side. On the basis of the capacity of the motor cylinders being 33 cubic inches, 300 revolutions of the pump at this degree of tilt will be necessary to rotate the motor once. If, however, the pump end socket ring be tilted further, the motor speed will increase, until at full stroke both ends are at one speed. Movement of the socket ring in the opposite direction causes the motor to rotate in the opposite direction, so that the gear is fully reversible.

The control may be either from a lever on one of the tilting box trunnions on the side of the casing or by hand

wheel on the top cover acting through a tooth sector on the top of the tilting box. This method may be arranged for distant control by lever or sprocket wheels if desired.

Keighley Technical College Radial Piston Type Hydraulic Drive.—In the design of the author's shown in Fig. 7 the construction consists of the driving shaft A with a large flanged extension attached to the cylinder block B so that the two revolve about the fixed centre C.

If the sleeve D is rotated by worm and wheel E the excentricity between C and F, which is shown at a maximum, neutralises and no stroke is given to the pistons, so that the oil pumped can be varied from zero to a maximum. It will be seen that as the value of the effective excentricity is reduced, the less will be the crank arm which the excentric forms in respect to the shaft A, so that when applying a constant torque to this shaft,

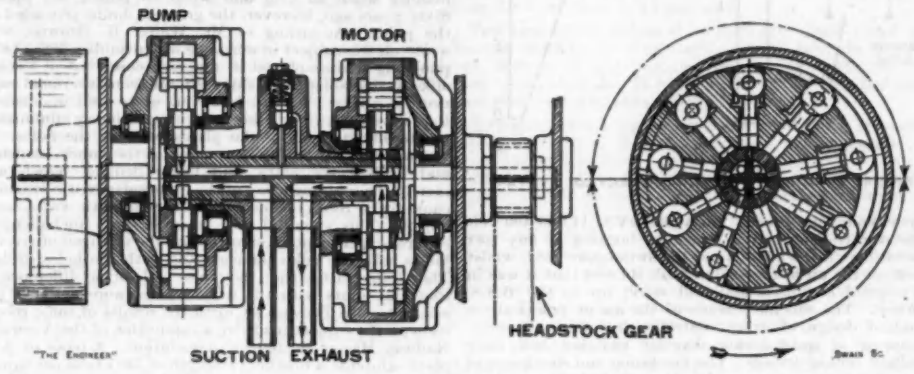


FIG. 8—HYDRAULIC DRIVE (LAUF-THOMA)

varying pressure and delivery in inverse ratios will be obtained when used as a pump, for the efforts on the pistons and the pressure developed are increased.

The arrangement is duplicated on the right-hand half to form the motor unit. The maximum speed is obtained when the excentricity is small and the minimum when in the position shown, for decreasing the excentricity and, consequently, the motor piston stroke means that less oil is taken up at each revolution so that it must revolve more quickly, seeing that the volume of oil from the pump is constant.

Suction oil enters at G and passes into the distributor H, which is integral with the worm wheel. After passing through half a revolution it is delivered under pressure to the opposite side of the distributor H and forwarded to distributor J of the motor unit in order to act on the pistons which are forced down to rotate the motor. Again, after half a revolution the exhaust oil enters the opposite side of the distributor and passes back to the reservoir through hole K. The distributors are fixed to the excentric sleeves and move with them when rotated. This is necessary because any manipulation of the excentrics causes the dead centres of the arrangement to move by an amount equal to the angular displacement of the excentric. The various settings and relative positions of the distributors for pressure and speed regulation are shown in the lower views. The nine pistons are pivoted on studs fitted on rollers running in the guiding track, these tracks being mounted on roller bearings carried by the excentric sleeves. In order to maintain oil-tightness between the faces, end pressure is maintained by the adjustable spring L, which also serves the purpose of a safety valve if the pressure becomes excessive.

Lauf-Thoma Hydraulic Drive.—The construction and operation of this drive are illustrated in Fig. 8, and consist of a piston pump and motor. The pump is driven at constant speed and draws up oil from a tank. The stroke of the pistons may be varied and the delivery of oil corresponds to the speed and setting of the stroke. The oil is led to the motor, the speed depending on the quantity of oil introduced, but adjustment of stroke may also be provided in the motor, which extends the range of control. The gear is protected against overload by a safety valve. The flow of oil is through a central shaft, which has a number of holes bored through it. Around this shaft, which is stationary, the cylinder blocks are mounted to rotate, these being connected to the driving and the driven shafts. In their radial bores these cylinder blocks carry the pistons which are guided by crossheads in the block and are supported by rollers against the inside of a drum, running on ball bearings. These ball bearings are carried on a movable slide, and by moving this slide the excentricity of the drum in regard to the centre shaft, and consequently, the stroke of the pistons, is varied. With the drum central the pistons make no movement, but movement of the drum laterally causes the pistons on one side to suck in oil. On the opposite side this oil is forced through the holes in the centre shaft by the incoming pistons to the motor. The drum of the motor is usually at its maximum lateral adjustment, so that a further increase in the motor speed from that obtained by the pump can be obtained by decreasing the excentricity and, consequently, the piston stroke of the motor. The drums, which are mounted on ball bearings, are carried around by slight frictional contact and run at the same speed as the cylinder blocks. The rollers of the pistons do not, therefore, rotate on the runways of the drum, but only execute a swinging movement corresponding to the movement of a connecting-rod in the crosshead of an ordinary crank drive. All moving parts of the gear have cylindrical bearings to facilitate the attainment of exact fits.

(To be continued.)

A SYSTEM of mending "dipped" railway metal joints, caused by worn fish-plates, has been devised by the South African Railways Administration. The bend is first taken out of the rail by laying on the top of it a stiff girder and pulling the rail up to it by means of a jack and stirrup. Extra large fish-plates are then fitted.

British Standards Institution.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

STEEL PIPE FLANGES.

No. 10, Part 5—1932. This new B.S. specification relates to flanges for steam pressures above 900 lb. and up to 1400 lb. per square inch. It may be considered in advance of practice and is issued as a tentative standard only.

The new Table "T" of Flange Dimensions is based on a maximum temperature of 800 deg. Fah., but corresponding to a suitable decrease in the pressure below the maximum of 1400 lb. a temperature up to 820 deg. Fah. may be allowed as a maximum.

The specification requires that alloy steel bolts of high tensile strength shall be used for the flanges of pipes when used for steam above 750 deg. Fah., thus following the practice established for the two previous Tables "R" and "S"; but this is the first time that a B.S. Flange Table has specified fine threads for the bolts. The object is to gain additional strength and to enable the alloy steel stud bolts to be more readily distinguished from those of mild steel.

Special interest attaches to the table included with this issue, relating to the permissible application of this and previous flange tables for use with steam at different degrees of superheat and with water at 450 deg. Fah., as it enables a wider use to be made of the tables and shows their application to high-pressure feed piping.

The specification for the material for the stud bolts is in general agreement with the similar specification issued with the flange tables for 600/900 lb., but differs slightly in the chemical contents of the alloy steel.

The Committee responsible for this specification considered that the material on the outside of the flange is of little use, and it has kept the pitch circle as small as possible so as to bring the bolts near to the bore of the pipe.

ANNUAL REPORT AND INDEX OF SPECIFICATIONS.

The Institution has recently issued in one volume the report presented at its last annual general meeting and an indexed list of British Standard Specifications.

This list, which covers 40 pages, includes both a numerical list and a complete subject index. Copies are available. Price 1s. 2d. post free.

On-Load Transformer Tap Changing Gear.

WITH a view to reducing the cost of on-load transformer tap changing gear and increasing its field of application, Crompton Parkinson and Co., Ltd., of Chelmsford, have introduced a new and ingenious system. The high cost

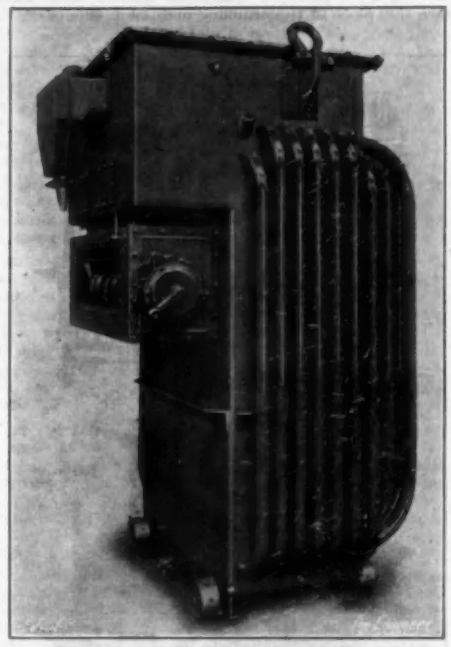


FIG. 1—TRANSFORMER AND CONTROLLER

of the usual apparatus is believed to have been an obstacle to its more general adoption, and it is hoped that this new and cheaper type of gear will cause transformer users to give on-load tap changing more attention. All the equipment for changing the tappings can be accommodated partly in the transformer tank and partly in an oil-filled box, as shown in Fig. 1, which is a 500-kVA three-phase delta-star connected transformer with a ratio of 10,750/410 volts and capable of giving a constant secondary voltage by means of a plus or minus 5 per cent. variation on the primary side. From the diagram of connections (Fig. 2) it will be perceived that the high-voltage winding is divided into two nearly equal portions with tappings near the centre of the complete winding for the dual purpose of preserving the magnetic balance and protecting the tappings from the effects of possible surges or similar disturbances on the mains. To some extent the switchgear resembles that in general use for transformer regulation. A system of compensating coils with a mid-point connection is used in conjunction with a selector switch and gives a number of regulating positions roughly equal to twice the number of transformer tappings. The compensating coils have laminated cores and are usually mounted on top of the transformer, as shown in Fig. 3, and are enclosed in its tank.

The design of these coils constitutes the chief feature of the system. Whereas the majority of on-load tap changing equipments involve the use of oil-filled diverter switches

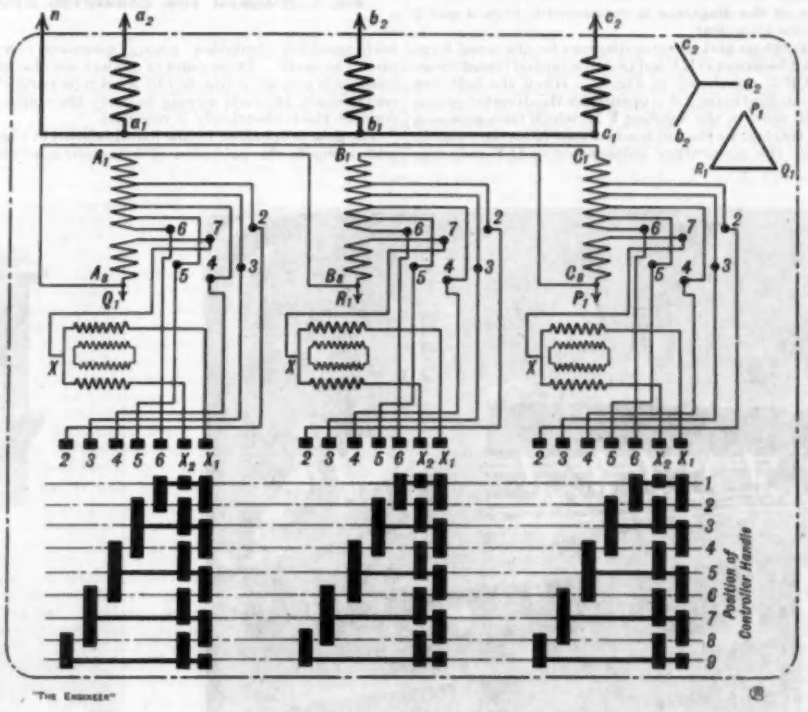


FIG. 2—TRANSFORMER AND CONTROLLER CONNECTIONS

for the purpose of "diverting" the load before the operation of the selector switches which would otherwise be damaged by arcing, the system under consideration avoids the employment of these switches. As is well known, in order to prevent the deterioration of the oil in the main tank it is necessary to mount diverter switches in a separate tank, with the result that the provision of these switches adds considerably to the cost of the tap changing equipment.

In the new system, however, arcing tendencies are removed by a patented system of transformers, which takes the place of the ordinary mid-point balancers. A

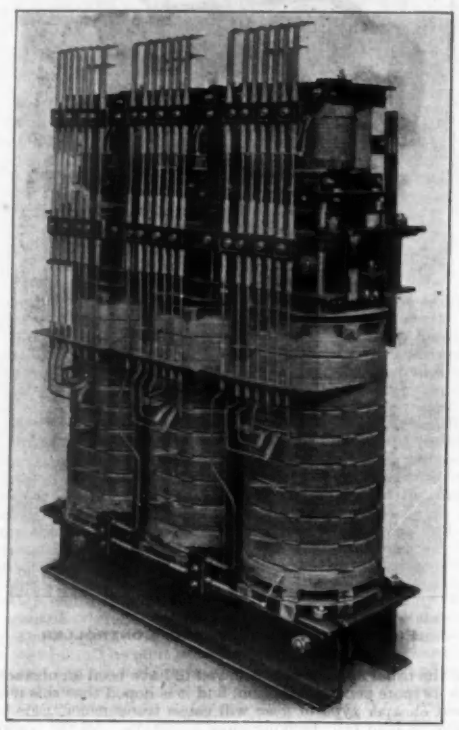


FIG. 3—MAIN AND COMPENSATING TRANSFORMERS

comparison of the diagrams of connections, Figs. 4 and 5 will make the idea clear.

The connections and a vector diagram for the usual form of mid-point balancer D E F applied to a tapped transformer winding A B C are shown in Fig. 4. When the balancer connection to the tapping B is opened by the diverter switch current still flows in the winding F E, which then acts as a choke coil and carries the full-load current from the point C. In this case the momentary voltage across D F may rise as shown, but no current if both primaries are connected to a single tap. Let us now consider what happens when the circuit B–D is broken. The primary current in D E begins to fall and consequently the voltage in H J also falls. As the load current in G–F is still flowing, the voltage in L–K still operates, and owing to the reversed secondary connections it sends a reverse current through H J, thus tending to induce an E.M.F. in D E equal and opposite to the E.M.F. previously produced by the load current, and in consequence the resulting voltage across the break is very little higher than the tap voltage B–C.

Actually this voltage is so low that after a test run of

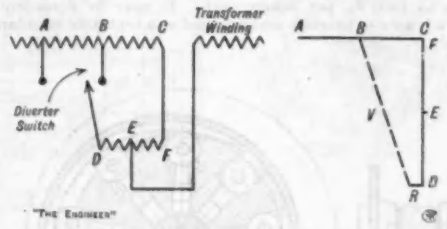


FIG. 4—DIAGRAM FOR UNCORRECTED SYSTEM

50,000 complete breaks on a 500-kVA 11,000/400-volt delta-star transformer no mark or burning of any sort was visible on the contacts of the switchgear used, whilst a test on the oil in the switch tank showed that it was in its original condition and still stood up to the B.S.S. 148 test. The scheme permits of the use of practically a standard design of drum controller free from the complications of quick-acting diverter switches and their ancillary timing devices. The insulation and clearances of the switch are, however, modified to suit the higher working voltage and provision is made for total immersion in oil. The drum is built on a heavy hexagonal steel bar

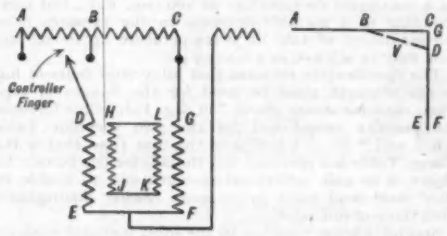


FIG. 5—DIAGRAM FOR CORRECTED SYSTEM

with moulded insulation, giving generous creeping distances to earth. Three pairs of spiders are clamped on the insulation and are connected by steel rods parallel with the centre shaft, the rods serving to carry the contacts and to connect them electrically if required.

The gear is operated by the handle shown in Figs. 6 and 7, and owing to the provision of reduction gear one revolution of the handle gives one voltage step. At all times the drum is locked to the handle, which can be padlocked on any step, which is indicated by a digit appearing in the front of the handle box, as shown in Fig. 6. Remote operation with or without automatic control can be arranged when desired. For this purpose a standard motor control pillar is placed immediately adjacent to the switch casing and is connected to it by a universal shaft coupling. The operating handle is, of course, removed, but an emergency handle is provided for use in the event of the failure of the supply of current to the motor. The operating pillar provides for push button control in either direction, and audible and visible alarms can come into operation whilst the tappings are being changed. Limit switches are also provided to prevent the motor attempting to drive the controller beyond its proper range. The motor supply may be D.C. or A.C., and in the latter case it may be taken direct from the controlled transformer so as to avoid the possibility of local interruptions. Automatic control by voltage with or without compounding and hand adjustments for normal voltage, line impedance and compounding may be included. Two or more regulating transformers may also be arranged to run in parallel under the control of one voltage relay panel.

The illustration Fig. 7 shows the application of the system to a 500-kVA transformer which was not originally built for voltage control by switchgear, and it will be seen that the whole of the tap changing equipment, including the compensating transformers, is carried in a casing attached to the outside of the main tank.

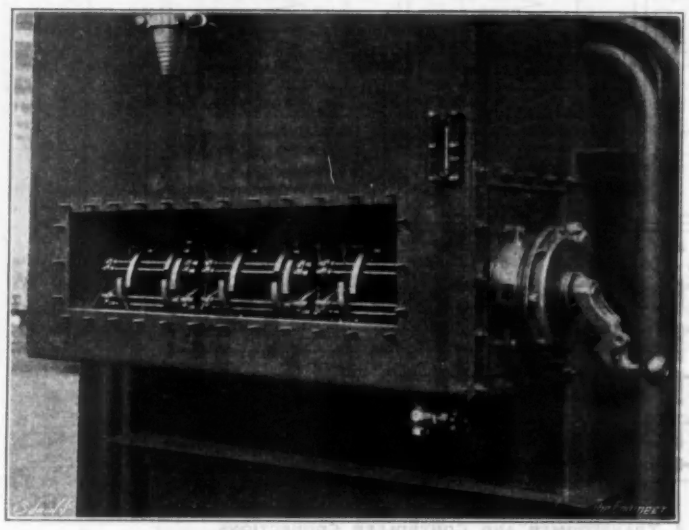


FIG. 6—FRONT VIEW OF CONTROLLER

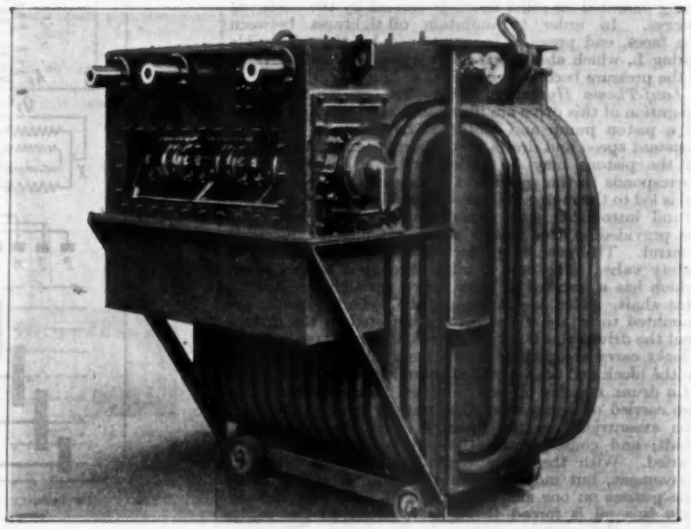


FIG. 7—TAP-CHANGING GEAR FITTED TO EXISTING TRANSFORMER

to a value many times greater than the step voltage B C, with the result that there is a considerable tendency for an arc to occur at the break, thus necessitating the provision of the diverter switch. The vector diagram shows the probable value of the balancer voltage D E F as compared with the step voltage B C, the angle between the two at unity power factor load being 90 deg. If the line R be taken as a measure of the resistance of the copper in the balancer, then the dotted line V indicates the extent of the arcing voltage B–D, which may obviously be considerably greater than the step voltage B–C.

The Crompton Weaving patented system of tap changing by means of compensating transformers is shown diagrammatically in Fig. 5. The tapped part of the transformer winding is marked A B C, as before, whilst D E F G indicate primary windings of the compensating transformer and J H K L a secondary winding mounted on the same core. The windings J H and K L are connected so that they oppose each other, and therefore only carry a circulating current when their respective primaries D E and F G are in parallel and are connected to the taps B C,

SIXTY YEARS AGO.

WE seem to have settled nowadays in a fairly defined manner when to drill and when to punch our plates. Sixty years ago, however, the greatest doubt prevailed on the point. According to Mr. Walter R. Browne, who wrote on the subject in our issue of November 29th, 1872, punching was employed in nineteen cases out of twenty alike in the boiler shop, shipyard, and constructional engineering works. It was, however, quite well understood that in some way or other punching seriously diminished the tensile strength of the plates between the holes. It was argued that the violent action of the punch hardened and bruised the plate, and hence drilling, which was merely the scraping away of the iron under gentle pressure, came to be recommended whenever strength was a main object. This view did not, however, pass unchallenged. Several experimenters investigated the strength of riveted joints with the holes punched and with the holes drilled. They found either that there was little or no difference or that the joints with the drilled holes were actually the weakest. Mr. Browne set forth the results of some recent tests on the subject made by a committee of the American Railway Master Mechanics' Association. A piece of $\frac{7}{16}$in. plate exhibited a breaking strength of 26·7 tons per square inch. If a $\frac{7}{8}$in. hole were punched through its middle it gave a breaking strength of 17·1 tons. If the same size of hole were drilled through the middle it showed a breaking strength of 22·4 tons. Here, then, seemed to be clear evidence in favour of drilling, although as Mr. Browne, pointed out, the figures also provided evidence that the customary practice of assuming that a drilled plate possessed the full strength corresponding to the undrilled sectional area at the centre line of the hole was not well founded. For, he believed, the first time, he gave an explanation of why a plate with a hole in it must possess less initial strength than an undrilled plate. Next he called attention to the results obtained on testing two $\frac{7}{16}$in. plates united by a riveted lap joint, the holes in one test being punched and in a second test drilled. The punched plates failed under a load of 22·3 tons per square inch measured on the section at the centre line of the rivet hole. The drilled plates failed when the stress at this section was 20·8 tons per square inch. The drilled holes therefore gave a worse result than the punched holes. Seeking the explanation of this result, Mr. Browne pointed out that when the punched plates failed they failed by the tearing of the plates, whereas in the case of the drilled plates failure occurred not by the tearing of the plates, but by the shearing of the rivet. The conclusion arrived at, therefore, was that drilling did less damage to the strength of a plate than punching, but that rivets in punched holes were stronger than rivets in drilled holes. Some attempt was made to explain this anomaly, the most favoured opinion being that the sharp edges of the drilled holes taxed the rivet more severely than the roughened bruised edges of the punched holes.

THE October returns issued by the National Federation of Iron and Steel Manufacturers show that there were fifty-nine furnaces in blast at the end of October, the same as at the beginning, two furnaces having been blown in and two blown out. The production of pig iron amounted to 275,600 tons, compared with 260,400 tons in September, and 284,200 tons in October, 1931. There was thus a slight increase in the daily rate compared with September. The production included 58,400 tons of hematite, 134,200 tons of basic, 66,900 tons of foundry, and 9600 tons of forge pig iron. The output of steel ingots and castings amounted to 438,500 tons, compared with 430,300 tons in September, and 457,400 tons in October, 1931.

Railway and Road Matters.

WHAT we hope is a sign of the times is that the Southern Railway had, in the forty-fourth week of the year, an increase compared with the corresponding period of 1931, of £1000 in its passenger traffic, £2000 in goods traffic, and £1000 in the coal traffic.

IT was recently stated in the House of Commons, in response to a question addressed to Mr. Pybus, that during the month of October last seventeen railway servants were killed and 1236 injured, as compared with eighteen killed and 1428 injured during the corresponding month of 1931. The figures for the ten months of the present year were 167 killed and 12,284 injured, as against 165 killed and 13,845 injured in 1931.

A QUESTION by Sir Philip Dawson on November 9th, permitted the Minister of Transport to state that the London and North-Eastern Railway officers had informed him that they have schemes of London suburban electrification under consideration, and that in the event of the London Transport Bill becoming law, they will be prepared to submit proposals to the Standing Joint Committee of the Transport Board and the railway companies which the Bill proposes to set up.

THE Board of Trade inquiry into the stranding, during a dense fog on August 5th, of the Great Western steamer "St. Patrick," off Corbière, when running from Weymouth to Jersey, was held during the week commencing Monday, November 14th. As judgment was reserved, we can only record a note that evidence was given that it was a quarter of a century since anything had happened to a Great Western boat on the Channel Islands service, and during the long history of that service no passenger had been either killed or injured.

THE Japanese Government Railways, for the year 1931–32, managed to keep the reduction in revenue to merely nominal proportions. The total revenue was 433,540,288 yen, a drop of 5·3 per cent. on the figures of the previous year; but the working expenses fell by 6·5 per cent. to 266,634,480 yen. After paying all interest charges, subsidies, &c., a net profit of 68,451,761 yen remained, this representing practically 2 per cent. on the capital, against a figure of 2¼ per cent. for the previous year. At the moment there are approximately 14·5 yen to the pound sterling.

MENTION was made herein on July 22nd last of the Minister of Transport's intentions to have the causes of all fatal road accidents recorded on a return, the form of which had been for some time in preparation. At a conference on November 16th, of representatives of the Home Office, the Scottish Office, the Commissioners of Police for the Metropolis and for the City of London, the Chief Constables' Association, various motoring interests, the Pedestrians' Association, the National Safety First Association, and of the Coroners' Society, the form of return and the instructions were considered in detail and various amendments were suggested. It was announced that it was the Minister's intention that the official investigation, conducted through the police, into fatal road accidents, should start on January 1st, and should continue for a period long enough to furnish reliable data.

ANOTHER very able and popular railwayman has retired. We refer to Mr. J. E. Anderson, the superintendent of motive power, London, Midland and Scottish Railway. He served his time with the Great North of Scotland Railway and had subsequently been with Sharp, Stewart and Dübs, the Glasgow and South-Western Railway, and with Robert Stephenson and Co., when, in 1903, he went to the Midland Railway at Derby, where, by 1913, he had become works manager. During the war and Sir Henry Fowler's absence from Derby, Mr. Anderson was the acting chief mechanical engineer, and in May, 1919, he was appointed deputy chief mechanical engineer. On the formation of the London, Midland and Scottish Railway, Mr. Anderson was made the superintendent of motive power. As recorded in our Seven-Day Journal on November 18th, Mr. Anderson has been succeeded by Mr. D. C. Urie, who, in turn, has been followed, as Divisional Mechanical Engineer, Scotland, by Mr. H. G. Ivatt, the works manger at Derby. It is good to have such eminent names as Urie and Ivatt in the locomotive world perpetuated in this way.

IN our mention of the disaster that befell a gang of platelayers near Watford, L.M.S.R., on November 9th, we referred to changes in the rules that had been made in order to give greater security to men when working on the permanent way. One of the rules that followed the Railway Employment (Prevention of Accidents) Act, 1900, was that ordering the protection of men, working singly or in gangs, in all cases where danger was likely to arise. That protection was to be given by a look-out man, who should be "expressly instructed to act for such purpose, and provided with all appliances necessary to give effect to such look-out." As a result of a gang of eight men being run down, of whom four were killed, near Camlachie, on the North British Railway, on November 11th, 1911, Sir Arthur Yorke, made a report in which he said that though fifty-seven of the companies, including the most important, had accepted the Board of Trade recommendation to provide whistles to the men, the North British was one of forty-seven companies which had refused to give whistles. Sir Arthur's report became memorable for two of the observations he made. One was: "It is pathetic to think of these men carrying out the duty which had been laid upon them, and waiting for the word of command to cease work and to seek safety, which never came because there was no one to give it, or listening for the shout of warning, which, owing to the negligence of the look-out man, came too late." The other comment was: "Little or nothing is ever said regarding the risks to permanent way men, and the subject is one which urgently calls for attention. It must be admitted that a considerable number of the accidents appear to be due to the men's own want of caution, but this only proves that the men are so helpless, perhaps in some cases reckless, that it is all the more necessary to protect them and not turn them on to a railway like a flock of sheep without a shepherd to guide them."

Notes and Memoranda.

IT has been calculated that in Europe the progressive expansion of water power is annually displacing 5 million tons of coal, whereby annually 5000 miners become superfluous.

BY the adoption of electricity in the place of oil for illuminating the lighthouse on the Bluff at Durban, Natal, the candle-power has been increased from 150,000 to three millions.

IT is estimated that the installation of an economiser and testing instruments will increase the efficiency of the boiler plant at Vereeniging station of the Rand Water Board from 62·3 per cent. to 75 per cent.

THE new bridge across the Forth and Clyde Canal at Temple, built by Sir Wm. Arrol and Co., is of the single-leaf, deck type, and is raised by electric machinery to allow vessels to pass. It has a weight of 700 tons and has cost, with its approaches, some £75,000.

A SHOVEL with a dipper having a capacity of 18 cubic yards, or 27 tons, of earth, has been commissioned in the Pittsburg coalfield. It is electrically operated and requires 3000 H.P. The digging height is 80ft., and it requires only 45 seconds to complete a cycle of operations.

ACCORDING to Commander A. N. G. Firebrace, Divisional Officer, London Fire Brigade, it is possible that in the future the existing first-aid pump and 40 gallons of water carried by an escape may be superseded by some fire-extinguishing system which used an inert gas instead of water. This would eliminate water damage and obviate much of the clearing up now necessary after a fire.

THE French Société des Hauts Fourneaux de la Providence has placed on the market a new corrosion-resisting steel under the name of "Provinox." Its ultimate tensile strength is 22 to 25 tons per square inch; the elastic limit ranges from 70 to 80 per cent. of the ultimate strength. The extension exceeds 30 per cent., and generally reaches 34 to 36 per cent. The steel can, it is said, be worked hot or cold. It can be punched, drawn or used for rivets without any difficulty. The rivet heads can be formed at a comparatively low temperature.

IN order to prolong the life of telegraph poles and posts buried in the ground a process of charring the wood with an acetylene flame has been developed largely in Australia. According to Mr. H. C. Morgan, of the Australian Welding Institute, with this system there is absolutely no risk of destroying sound wood, but sufficient heat is generated to cleanse the pole of all decay, even though it may appear to be sound on a visual inspection of the surface. The decayed wood, when at all dry, burns very quickly, emitting a fierce sheet of flame and an intense light, which renders the use of coloured glasses necessary for scouring. As soon as all the decayed timber and fungus growth has been burnt out the emission of flame and light ceases, and the sound wood which is left commences to char. The distinct change in the character of the flame indicates clearly the removal of all unsound material. Where the fungus has entered the pole by means of a check and formed an internal pocket of decay, the emission of flame is almost explosive in its violence.

THE mixture "Aral," widely used in Germany for motor fuel, says the *Chemical Trade Journal*, consists of 60 parts by volume of benzine and 40 parts by volume of benzole. It has the following properties:—Sp. gr., 0·795 to 0·800; freezing point, below −35 deg. Cent.; heating value, about 8100 kilogramme-calories per litre; and octane number, 82 to 85. The ternary mixtures first contained 10 per cent. by volume of alcohol, but this proportion is now usually 15 per cent. Whilst absolute alcohol is miscible with benzine and benzole in all proportions, the presence of small amounts of water makes a vast difference. In benzine-benzole mixtures with 10 per cent. of alcohol, the water content to produce turbidity is 0·6 per cent., whilst for the 15 per cent. alcohol mixture the water content to produce turbidity exceeds 1 per cent. The effect of the addition of alcohol is to lower the freezing point of the mixture and to increase its anti-knock powers, the octane number of the present mixture employed in Germany being up to 92.

ACCORDING to Mr. G. Shapiro in the *Electrical Review*, the Electro-technical Research Institute in Moscow is reported to have developed a process whereby an oxide film can be deposited on aluminium wire to withstand several hundred volts. This oxide film possesses good insulating, heat-resisting, and heat-conducting properties; it is flexible, mechanically strong, and capable of withstanding shocks and friction. In the event of a local puncture, the heating by the spark will produce an intensive oxidation of the bare metal, which will then again be covered with an insulating film. The extreme thinness of the oxide film, its good heat conductivity, and the large surface in contact with air create exceedingly favourable conditions for cooling, which, taken in conjunction with the very high heat resistance of the oxide film (whose melting point is 2500 deg. Cent.), make possible a very considerable increase of the permissible current density. Moisture, chemical reagents, and corona do not affect it. It is also very hard, and is not subject to ageing.

IN the course of a lecture before the Royal Institution, Professor E. N. da C. Andrade said that "In modern electric lamps over 90 per cent. of the energy supply is sent out as radiation, but of this, even in the very best lamps, only about 10 per cent. is visible to the human eye, the remainder being invisible infra-red or heat radiation, which is pure waste as far as illumination goes. An enormous fortune awaits any body who will discover how to make 'cold' light—that is, visible light without infra-red heat radiation—on an industrial scale. So far the most efficient makers of light are the luminous insects and bacteria, which know how to carry on chemical reactions so as to produce cold light. Experiments show that the firefly, for instance, is very much more efficient than any human system of power stations and lamps. The light of the firefly would be a little trying as an illuminant, for it is greenish, but if we could go so far as to imitate the method of production, no doubt we would soon learn to modify the colour. All the light produced by the firefly lies in the range visible to the human eye."

Miscellanea.

IT is said that pitch in considerable quantities is being exported from Canada for use in France as a binder in the manufacture of coal briquettes.

THREE Yarrow water-tube boilers are to be supplied for the power station at the new steel works at Pretoria, of the South African Iron and Steel Industrial Corporation.

THE L.N.E. Railway has completed comprehensive schemes of renewal and reconstruction of locomotive depôts at King's Cross, Peterborough, Cambridge, Frodingham, and Gorton.

WITH practically no interference to either road or rail traffic, railway engineers successfully concluded the task of replacing the 120-ton bridge over Edgware-road, W., by a new structure weighing 180 tons.

SPECIFICATIONS recently issued for the Aswan dam power scheme (Egypt) have been called in by a special *Gazette* notice, which explains that Parliamentary sanction is necessary before the scheme can be put into operation.

THE new creosote oil substitute for petrol has been found under test to be so successful that the Belfast Omnibus Company has decided to convert an additional twenty-eight omnibuses to the use of the fuel, making forty in all.

IN connection with the 5,000,000-dollar relief works programme of sewers being carried out in Montreal, the administration intends to employ three eight-hour shifts per twenty-four hours, with wages for common labour at 40 cents an hour.

A REMARKABLY quick turn-round is reported by the L.M.S. Railway from Goole docks, where on November 5th the s.s. "Arufa" arrived at noon, commenced loading coal from the L.M.S. Railway's 32-ton hoist ten minutes later, and by 5 p.m. had taken on board 1461 tons of cargo, coal, and bunkers. The vessel sailed on the evening tide the same day.

PLANS for deepening the east channel of the Niagara River from North Tonawanda to Niagara Falls, at a cost of 500,000 dollars, are being completed in the district engineer's office at Niagara Falls. Water-borne commerce now reaches Niagara Falls through the west channel. The east channel provides a much shorter route. It is, says the *Engineering News-Record*, expected that bids can be called in time to start the work in the spring.

WE have received from Barimar, Ltd., two photographs showing one side of the beautiful cast iron entrance gates of Beddington Park, Wallington, Surrey, which were recently severely damaged by a motor cyclist who ran into the gates in the dark. The broken side stands about 10ft. high, is 5ft. wide, and weighs approximately 15 cwt. One photograph shows how the gate was broken in several places, and the other its restoration to its original condition by welding.

FIFTEEN plants in Canada report a production of 221,731,292 lb. of steel wire in 1931. Much of that went into the manufacture of nails, screws, galvanised wire, &c., in the same plants. The amount sold as steel wire was 42,556,818 lb., valued at 1,446,997 dollars. Galvanised wire was made to the amount of 62,579,211 lb. and 26,344,303 lb. sold at 853,049 dollars. Other coated wire was produced to the amount of 8,030,749 lb. and 6,877,448 lb. sold at 305,660 dollars. The amount of barbed wire produced was 8,743,437 lb. and 12,466,120 lb. sold at 376,291 dollars.

IN the course of a speech made at the opening of a Gas Exhibition at Lincoln on Tuesday last, November 22nd, Sir Francis Goodenough, Chairman of the British Commercial Gas Association, said that as a national industry the gas industry was deeply concerned that the nation's greatest material natural asset—coal—should be used in the fullest and most profitable way to the nation at large. It was well to remember that even where gas displaced coal the collier kept his job. The best way back to coal, back from imported oil to home-produced fuel, was, he suggested, through the gasworks and the electricity generating stations, which between them enabled industry to obtain heat and power from coal with an increase in efficiency of production as well as a marked improvement in conditions of labour, and without fouling the atmosphere of our towns and cities.

THE cracking of insulators is due to faulty technique that completely or partially disregards thermal stressing in service, says Mr. R. C. Andersen. Furthermore, this disregard, generally, is fostered by specifications devised to ensure high electrical, electro-mechanical and purely mechanical characteristics in a test room. The drafting of these specifications is inspired by the fallacious belief that a good test insulator must be a reliable insulator in service. Resiliency of assembly is absolutely vital, but it must be borne in mind that this resiliency, while it results in insulator longevity, militates against high electro-mechanical test figures. Thermal stressing is responsible for some 90 per cent. of insulator failures, so that reliability in service can only be assured by those insulator shapes and assemblies which have been designed and manufactured effectively to counteract the dire effects of this thermal stressing.

THE development of Sweden's water power resources is being energetically pushed forward, and two of the biggest power stations in the country with a combined maximum capacity of about 210,000 H.P. are at present under construction. The Kraangede Power Company in North Sweden, which will deliver energy to Central Sweden as well as to the State Railways and to the city of Stockholm, will, when the Kraangede Falls are fully exploited, have a capacity of about 180,000 H.P. The main power line of that plant will have a length of 340 kiloms. and a tension of 220 kV, the highest in Sweden. Another big power undertaking is the Vargoen station, where there will be developed some 30,000 H.P. The turbines used are of the Kaplan type for working under a head of 4·3 m., and made by the Karlstads Mechanical Works and by the Nydqvist and Holm Works. The Vargoen turbines are claimed to be the largest of their kind ever constructed and have a diameter of 8 m. The motor for the generator alone weighs 194 tons.

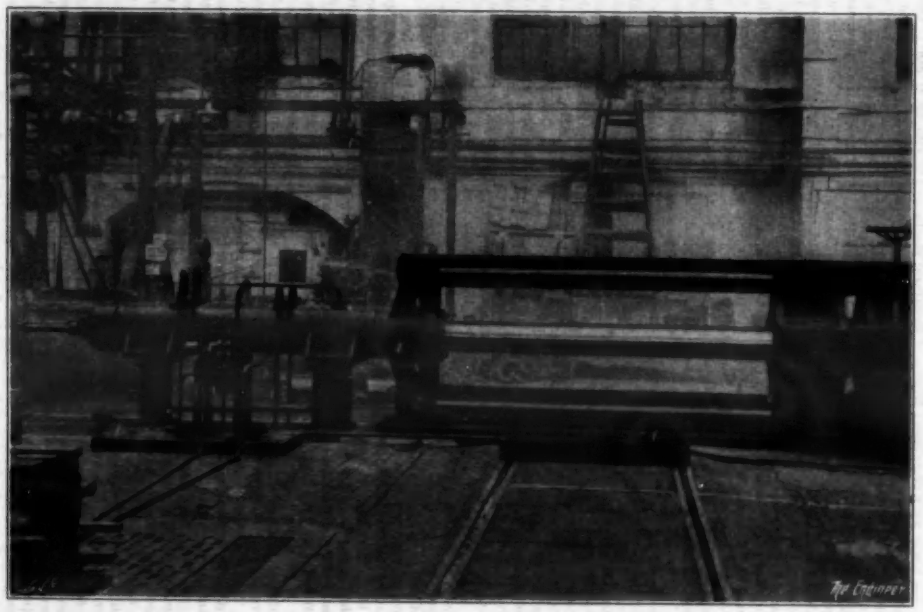
750-TON CHAIN TESTING MACHINE

W. AND T. AVERY, LTD., BIRMINGHAM, ENGINEERS

(*For description see page 542*).

GENERAL VIEW FROM WEIGHING END

WEIGHING END



STRAINING END

MAIN LEVERS, LINKS, SUSPENSION AND RECOIL GEAR

The Engineer

NOVEMBER 25, 1932.

VOL. CLIV. No. 4011

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The Metallurgist.

THE NOVEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

TRANSPORT AND ECONOMY.

IT is not for us to concern ourselves with any novelty there may be in the establishment of an Economy Committee by private members of the House of Commons, or to feel agitated by an irregularity in the circulation of the Report by that Committee—or should we say of "those Committees," since it appears that a number of separate committees have acted independently, and that the main Committee has not given its blessing, and does not approve, all their recommendations. These are trivial matters by comparison with the value and importance of the work as a whole. The Economy Committee was set up on June 20th last by the Private Members' Committee—an established organisation—as the immediate result of some remarks made by Sir Neville Chamberlain a few days before. Its terms of reference were "To inquire into the whole field of national expenditure, and to suggest broad lines of policy for effecting maximum economies without curtailing efficiency." "Members of all parties who support the National Government" were co-opted, and in order to expedite the work, five *ad hoc* sub-committees were formed to concentrate on particular aspects of the problem. These sub-committees endeavoured to survey the whole field of public expenditure, utilising every source of information available to them as unofficial investigators. No less than seventy-one members took part in the deliberations, and the bulk of the work was done in the parliamentary recess. Whatever views—and they are bound to be diverse—the public may hold upon the recommendations made by these Committees, the country cannot fail to be appreciative of the motives which inspired the work and the personal sacrifices made in pursuit of it.

In these days when scientists and engineers are being urged to throw their weight into national affairs, we almost hesitate to select for consideration the Report of any one of the five Committees. If we do so, it is not because we fail to recognise that engineers can and should use their influence to secure economies in many directions, but because our readers must naturally feel a preponderating interest in those subjects with which they are most intimately connected. Whilst, therefore, trusting that engineers will study with care the recommendations of the four other Committees, we turn our attention to that which, under the chairmanship of Sir Fergus Graham, inquired into the economies which could be made in "Transport and Roads." The first recommendation of this Committee is that the Ministry of Transport should be abolished. It is admitted that the Ministry is not a costly one as Ministries go, but yet, if we may venture to compare the less with the greater, and modify Falstaff's familiar appraisal of himself, it is not only a source of expenditure in itself, but the cause of expenditure in others, for, according to the Committee, "its existence and influence lead to extravagancies throughout the country, and Local Authorities are encouraged through its activities to embark upon grandiose schemes which they would not otherwise be prepared to undertake." This is a new form of attack, and an effective one. If it is true, then we have the fact that a Ministry which should have been jealous in the examination of schemes and the pursuit of economy, has encouraged needless expenditure. Hence, even if it does not act as a willing spur to extravagance, we must agree not only with this Committee, but with the Cabinet of 1927, that it should be dissolved, and the useful duties which it performs be undertaken by a smaller department "further removed from Cabinet rank" and "less attracted towards the initiation of great schemes." Its dissolution will be made the easier if the second recommendation advanced by the Committee be accepted by Parliament. That recommendation, adopted from the May Report, is "that the Road Fund be abolished." The Ministry of Transport has administered that Fund, and if the Fund goes, one of the strongest arguments in support of the Ministry will disappear. But apart from that, it is well known that there is a good deal of overlapping between the Ministry of Transport and the Board of Trade, for which there is not an atom of necessity. Such matters might be left in the hands of the Board, which managed them long before the Ministry was established. With the abolition of the Road Fund, other machinery for handling its revenues must be devised, and the Committee makes the recommendation not only that the expenditure on roads should be met by an annual Vote in Parliament, but that the revenue received from the road should go into the general exchequer. "The usufruct of motor revenue," says the Committee, "belongs to the nation at large, and cannot be considered a peculiar and personal right of the motorist." Whilst successive Chancellors of the Exchequer have acted on that principle, taking moneys from the Road Fund for other purposes, motor taxation has not, we believe, ever been officially regarded as un-earmarked revenue. Another recommendation in connection with the country's roads which is likely to evoke much criticism is that "no major scheme of construction or improvement should be considered before 1936." Furthermore, the Committee expresses the opinion that there is no need for "the present extremely high standard of maintenance." We are confident that an excellent case can be made out for the first part of this recommendation. Much of the expenditure has been incurred with the primary purpose of giving employment, and cannot be regarded as essential. On the question of maintenance much might be said. Whilst it is true that many roads are in an admirable condition, it is equally true that not a few leave a good deal to be desired. Before it would be safe to subscribe to the opinion of the Committee on this matter, careful investigation of the whole subject would have to be made. We fancy it would be found that whilst in some places the maintenance was extravagant, in others it was less than desirable. Hence, whilst a wiser distribution of expenditure may be called for, we are uncertain that any saving could be effected. In this connection it is appropriate to mention that the Committee does not accept the Salter Report figure of £60 millions "as a reasonable future annual expenditure upon roads." It is unanimous in the conclusion "that expenditure in the past has been on an unduly lavish scale, and in the interests of sound administration should be reduced. An additional drastic reduction is essential, owing to the reduction in the national income," and it thinks that in no circumstances should an annual expenditure of more than £50 millions be exceeded.

It will be gathered from this very brief presentation of but a single section of the Report that economies of a drastic nature are recommended. At this time, when the principles of economics are disturbed by the necessity of giving employment, the first general criticism of the Report will be that if the Government adopts any of the plans proposed, it will inevitably throw people out of work. We believe that to be a very superficial view. There are unquestionable signs that trade is beginning to improve, and there is equal evidence that excessive taxation will continue to hamper its recovery. Plausible as the contention may seem that money collected by the State and poured out by the State, is not lost to industry or the country, yet the indisputable fact remains that capital left in the hands of the directors and organisers of industries is more fruitful than any expended by the Government. In fact, a large proportion of the money earmarked for the payment of taxes, and the taxes themselves during the time that they are reposing in the coffers of the State, are either wholly unfruitful or are far less fruitful than they would be if kept in continual circulation in industry. The total State expenditure chargeable against revenue is now approximately four times as great as before the war. Admittedly, a large proportion of that expenditure is the outcome of the war years, but when that is taken into account, can it be justly said that the country is receiving value for its money? Every authoritative body that has examined the question has come to the same conclusion, that heavy taxation is doing injury to the trade and industry of the kingdom, and has urged, particularly, the immediate reduction of direct taxation. That can only be accomplished by the exercise of national economy, and although such economy may seem likely in the first place to cause greater distress, we are convinced that in the long run it will prove a blessing by encouraging that improvement of trade which has already begun.

The Man-in-the-Street and the Railways.

Two men, we are told, meeting in Manchester one day last week, fell to discussing the prospects of British railways. They agreed that the situation was very bad, and that not only was there no sign of improvement, but that it was difficult to see whence relief could come until trade revived. What they thought had to be done was to prevent the railway situation from becoming worse—not so much for the sake of the stockholders or to maintain the pay of the railwaymen, but on the higher ground of the welfare of the State. The railway system, they agreed, is so closely woven into the national life that it is a matter of prime importance to the man-in-the-street that it should be held back, at all costs, from the desperate state towards which it appeared to be heading. There is a good deal to be said for this point of view. Much is being made of the effect certain policies will have upon the trader and upon the railway stockholder. Both these are important considerations that affect a wide area. There is, however, a large percentage of the people who are not to be found in either of these ranks, but whose daily life is touched, in some way or other, by the railway, and to whom the railway is a real need. A very important feature of the case is that this last party, though the least eloquent, is the most numerous of the lot, and therefore ought to make its influence felt the more. The man-in-the-street's dependence upon the railway is quite evident to him, but he needs help in the presentation of his case, and instruction how to utilise his own great power. The railway companies could aid him there in dozens of different ways. They could, for instance, state, in a graphic form, the number of passengers who use the railway yearly and their percentage to the total population; the vastness of the residential traffic, illustrated by diagrams showing how it is compressed into the peak hours; the number of workmen's tickets issued and the absurdly low fares at which they are sold; how the mails, newspapers, milk, fish, &c., are conveyed for the use of the people, how cheaply and how quickly, and the quantities of this traffic, which is, it is important to note, almost wholly railway-borne. Instead of, as in Manchester, going to the expense of posters to show that six or eight trains a day take five minutes less over the journey to or from Blackpool, or in issuing a notice to the Press that so many half-day trips had been run, would it not be better for the companies to tell the public a few of the facts as to the debt they daily owe to the railways, and so

create among the people a "travelling conscience" and get them to use their weight in the struggle for fair treatment for a concern upon which the public well-being so much relies. The "Underground" has done something of the kind, but rather spasmodically. The main lines have done little or nothing.

The time is opportune. Parliament reopened on Tuesday last, and the Minister of Transport will be expected to say something about the Salter Report on the Road-Rail Controversy. The situation there appears to be worse than it was in the summer, and instead of furthering a community of interests between road transport and the railways, both the original parties to the controversy have shown a formidable antagonism, and have raised among other sections of the road and rail users fierce partisanship. The earlier points of difference have been widened and aggravated, and any adjustment, by agreement or by pressure, will take months to bring about. Coupled with these complications there is the fact that the Government has its hands more than full with international questions, the country's finances, and unemployment. These, then, are not moments when the railways can hope for any help from Parliament, unless impelled by strong national pressure. Another factor makes the present an opportune time for some action to be taken. On Monday next, November 28th, the railway companies open at the National Wages Board their case for making the present 2½ per cent. reduction in some wages and of 5 per cent. in others into an all-round reduction of 10 per cent. This is a serious step, but the railways hope to justify it. Were the necessity for such severe measures to be proved, things might so work out that there would be a public demand for fair play for the companies—for the men, for the stockholders, and for the railways themselves, so that they can maintain the excellent services which are not bettered in any country in the world—and the Government might be urged, despite its preoccupations, to do something to ease the companies' burdens. The education of the public on the lines we have indicated would then be useful. The railways have nothing to be ashamed of; on the contrary, there is much of which not only they but the nation also may be proud. Such propaganda work would, however, be a new departure. Railways always have, in this and other respects, been ultra-conservative and reluctant to make their good deeds known. This is now less the case than formerly, but only in such minor matters as those we have already mentioned. A further exception must also be made in favour of the information that in these later years has been given by the railway chairmen at the annual meetings of the companies; but those occasions come only once a year, and the remarks are, in the main, read only by the shareholders. Surely, a wider field should know, to deal only with Sir Josiah Stamp's remarks at the L.M.S. meeting on February 26th last, that that railway's receipts last year fell by 7·35 per cent., but the expenditure was reduced by 7·79 per cent., and that the expenditure in 1931 was eleven millions less than in 1927. On the formation of the company in 1923 it had 10,316 locomotives, made up of 393 different types, but at the end of 1931 the total was 9032, of 261 types. A certain class of engine took 5½ weeks in 1925 for its heavy repairs which now need only six days; and the 28 days wanted in 1928 to carry out the repairs to a boiler had been reduced to 11 days; whilst other operations that took eight days are now done in less than half that time. The number of locomotives available for traffic had been increased by nearly 500 by the less time spent in repairs to boilers. In the civil engineering side, the economies effected were no less striking. Other details of a general character could be named, but these are examples of a tale that needs to be told, and the telling of which could not, we feel sure, but win sympathy for the railways in this their time of need.

The railway companies would, we consider, at once render their cause a useful service if they would answer the charge widely levelled against them that it was their own lethargy, indifference, and self-confidence that allowed the road interests to get so strong a foothold. The contrary is the case, but so much has happened during the last ten years that it is generally forgotten that the session of 1922 had before it a Bill, promoted by the London and North-Western and Midland railways group, for powers to convey traffic by road. But an earlier and stranger event is probably not remembered at all. That is that under the Ministry of Transport Act, 1919, the Minister was given power to establish and work transport services by land and water. The Bill of 1922 was drafted in such a way as to merit the confidence of traders. The rates were to be reasonable and subject to the approval of the Railway Rates Tribunal. There was a strong opposition, but, strange to relate, little of it came from road interests. The Bill secured second reading, but only by 146 votes to 141. In Committee, however, it had made greater progress, when, on the tenth day, a witness from the Ministry of Transport upset the whole scheme by suddenly raising objections which the companies could not accept, and the Bill was withdrawn. The Committee which considered the Bill evidently thought that it had been treated with some discourtesy, as it made a special report to the House, which, it is important at this time to know, ended thus: "The case for the petitioners was not fully before the Committee, but, subject to the possibility of eliminating unfair competition, the Committee are unanimously of opinion that it would be in the public interest to allow the fullest participation by the railway companies of this group and all competitors in the service of road transport."

Institution of Mechanical Engineers

HYDRAULIC OPERATION OF MACHINE TOOLS.

WHILE a certain amount of information descriptive of machine tools equipped with hydraulically operated motions has been published in our own columns and elsewhere, a comprehensive general treatment of the subject has, so far as is known, not been presented to English readers. The deficiency has now been made good by Mr. H. C. Town, of the Keighley Technical College, who, on Friday evening of last week, submitted a lengthy paper entitled "Modern Hydraulic Operation of Machine Tools," before the Institution of Mechanical Engineers. Mr. Town's paper, it may be remarked, has earned for him the "Water Arbitration" prize of £40, which the Institution awards biennially for the best paper dealing with a subject prescribed by the Council. The award was certainly fully merited, both by reason of the pains which Mr. Town had obviously taken to obtain full particulars covering every branch of his subject, and by reason of the practical first-hand experience of hydraulically operated machine tools possessed by the author. We begin a condensed reprint of the paper elsewhere in this issue.

The discussion was opened by Mr. E. W. Tipple, of Coventry. He was mildly critical of hydraulically operated machine tools; but his criticism, he explained, was intended to provoke thought rather than to hamper the progress of hydraulic operation. Dealing first with machines fitted with a simple gear pump and controlled by means of a throttle valve, he said that the feeds were slower in the early part of the day than they were later on, when the working fluid had become warmed up and its viscosity had fallen. Machines so fitted undoubtedly exhibited a tendency to jumpiness in their motion, which might in the case of drilling machines result in the breaking of the drills. The simple gear pump was to be preferred to the variable delivery pump on the score of first cost, but if it were necessary, as, apparently, it was in the case of a gear-pump-driven machine illustrated by the author, to fit two motors to operate the equipment for cooling the working fluid, something, or all, of the advantage of cost possessed by the gear pump system would be lost. Some makers, he thought, resorted to hydraulic operation unnecessarily. They used it, in effect, merely as a means of taking up backlash, and might just as well achieve the same end with purely mechanical means. Machines operated by variable delivery pumps exhibited a tendency opposite to that shown by gear-pump-operated machines. As the oil became warmed up, its viscosity fell, there was leakage past the pump, and the feeds slowed up. If, in a machine such as a turret lathe, the several motions required separate hydraulic motors or pumps, the complications became very great. It was possible, he thought, that we might yet come to adopt a single central pump working in conjunction with accumulators and serving all the machines of a group or a shop in common. The combined hydraulic pump and motor unit was very costly, and he could not exclude the possibility that developments in gear change boxes might soon provide a serious rival to such systems of transmission. He was very surprised to notice the author's statement regarding the difficulty of obtaining a chuck that would hold the work in a hydraulically driven lathe with sufficient grip to enable full advantage to be taken of the power available. He felt quite sure that there was more than one design of British chuck which would give satisfaction in that respect, provided it were not used in a ridiculous manner. He had had seen at Leipzig the two German hydraulically operated planing machines to which Mr. Town had referred, and had studied them closely. The table motion was distinctly jumpy. That trouble was a most difficult one to eradicate in such machines, and he did not believe that it would be overcome by means of the existing methods of operating the table hydraulically. Concluding, he remarked that while grinding machines were eminently suitable for hydraulic operation, there were other classes, such as shaping machines, which were quite unsuited for it. Those keenly interested in hydraulic operation ought to keep an eye constantly on the developments which were taking place in the electrical driving of machine tools.

Mr. H. E. Weatherby endeavoured to refute the impression which, he held, Mr. Tipple's remarks might have created, namely, that the hydraulic operation of machine tools was a subject full of troubles. Mr. Tipple, he said, had ignored the chief advantage of hydraulic operation, the saving which it effected in the cost of tools. Those costs might be reduced by as much as 50 per cent., and the saving would go a long way towards compensating for any additional expense involved in the purchase of machines with hydraulic transmissions. Hydraulic operation should, he contended, be confined to feeding motions, and should not be asked to do too much. Further, machine tool designers should co-operate with the hydraulic engineer. Working in close harmony they might cut the cost of the hydraulic equipment by as much as 30 per cent. Slipping of the feed motion had given some trouble in hydraulically operated machine tools, but slip compensators had been made available recently, and although they did not as yet enable screw cutting to be performed with a hydraulically operated motion, they ensured very fine and accurate feeding. Air in the hydraulic circuit had also been accountable for some trouble in certain cases, but in a properly designed equipment air drains would be provided and would overcome all troubles of that kind. The hydraulic operation of presses, such as assembling and straightening presses, was, perhaps, outside the range of the author's paper; but attention might be called to them to illustrate a feature of hydraulic operation in general. Hydraulic presses were being employed for pressing the valve guides into motor car engines. The presses were arranged to reject any oversize guides, the action following automatically upon the rise in pressure caused by the excessive resistance. He did not think that any other type of mechanism could be designed for the purpose that would give that important feature.

Mr. Littlejohn Philip spoke of the work which he did during the war on the hydraulic operation of shell lathes. Generally speaking, little seems to be known of that work even to-day, but it nevertheless attracted a great deal of attention at the time. An illustrated description of the machines was published in *The Ministry of Munitions Journal* for March, 1918, but because that journal was not publicly circulated, many among last Friday's audience probably heard of Mr. Littlejohn Philip's work for the first time on that occasion. He told the meeting that when he began to study the subject in 1915, he desired to use one pump for each machine, but that ultimately he adopted the principle of a central power supply with three-throw pumps and accumulators using water as the working fluid. Eighteen lathes were fitted to operate in all directions under hydraulic power, and they ran night and day without giving trouble. No difficulty was encountered from air in the supply, for all the mains were placed overhead and the pipes to the machines were brought down vertically. The control arrangements were very simple, and all intricacies were avoided in order that the machines might be capable of being operated by girls. It was found possible with the aid of the machines to produce 18-pounder shells from the black bar in 15¼ minutes, and to machine to the finished state 9·2in. shells with screwed-in base adapters in 2¼ hours. Two different pressures were used, namely, 750 lb. and 300 lb. per square inch. For certain movements the lower pressure applied first effected the light part of the duty, the higher pressure being subsequently applied for the final heavy duty portion of the operation. He still believed firmly in the virtues of the central power supply, particularly if large numbers of similar pieces had to be produced.

Mr. Tyler argued that many of the troubles to which previous speakers had referred were traceable to the low pressures which were used; 700 lb. pressure was low enough, and even 1500 lb. might be taken as the minimum desirable. For high and low-pressure systems the pressures might be 2 tons and 1100 lb. per square inch, but pressures in excess of 3 tons, even a pressure of 18½ tons, had been used. Simplicity was of the greatest importance, as Mr. Littlejohn Philip had said. The shells which Mr. Philip produced at Messrs. Spencer's factory at Melksham were among the best manufactured in the country. The tools were fed up against solid stops and worked to very fine limits of accuracy. He agreed with the principle of supplying the machines from a central pump feeding all the machines with high-pressure water. Any loss incurred through leakage was of insignificant importance compared with the simplicity and cheapness secured by dispensing with individual pumps.

Mr. Town briefly replied to the discussion, but as the criticisms of any one speaker had, in general, already been met by the remarks made by others, there was little for him to add. One important

point, however, was brought out. The new tool materials, such as Widia, introduced, he said, the necessity for making provision for speed ranges extending up to 1000ft. per minute. If, therefore, the lower speeds were required, gear-boxes to give the whole range became large and complicated. Hydraulic speed control overcame that difficulty.

Aircraft Exhibition in Paris.

THE annual Exhibition of Aircraft, which has been opened in the Grand Palais, Paris, shows what is being accomplished by French builders, but it does not convey an adequate idea of the effort which France has made, and continues to make, for the development of military and civil aviation. Less prominence is given to military machines, for sufficient reasons, and it may be observed that there has been of late a good deal of expert discussion on the true value of the aeroplane as a weapon, one authority going to the extent of affirming, with figures to support his argument, that no country can afford to build and maintain the number of machines that would be required, under war conditions, to destroy a city and its suburbs. Experts are inclined to rank the aeroplane as an auxiliary weapon which does not dispense with other arms, and for that reason a limitation of air forces would be more readily accepted abroad now than at the time when it was supposed that aircraft would provide the most effective and economical means of defence. So far as concerns civil aviation, there is nothing to deter the French from carrying out their elaborate scheme of development, except the cost. It will be completed in time, and in the programme of public works prepared by the Government it is intended to provide funds next year for the laying out of eighteen new air ports and eleven landing grounds, besides the installation of beam lights over air routes and the provision of facilities for research and experiment. The plans for organising air services in the Far East, across the South Atlantic, and over other routes were retarded by the failure of makers to produce machines to the rigid specifications imposed. These led to the designing of huge and heavy seaplanes, which were disappointing, particularly in taking off the water under load, but with the experience they have acquired French designers and builders are now turning out machines which have proved satisfactory in trials, and the manner in which such machines have been evolved is observable at the Exhibition. In their construction makers have been influenced, to a large extent, by German practice, which culminated in the "Do X," but they have followed their own conceptions in the application of those principles, with the result that the big French machines appear handier, partly because they are of lighter build. In recent years German aircraft firms have shown freely at the French exhibitions. This year they are hardly represented at all.

Last month, Latécoère, of Toulouse, who originated the Aéropostale and supplied machines for the service to South America, carried out trials with a new seaplane which had been on the stocks for a considerable time. It is intended for the service between Dakar and Brazil. The width of the machine along the plane is 44 m. and its weight is said to be 23 tons. The machine is not exhibited, but the spar of one half of the plane is shown in order to convey an impression of its enormous size. This appears to be the only survival of the several experimental machines built by makers for the South Atlantic, and if the new seaplane is successful it will have been completed in time, for Dr. Eckener signed a contract in Spain recently for the installation of landing grounds at Seville in connection with the South American airship service, which will start to run regularly next year. The airship service has seriously compromised the prospects of the unfortunate Aéropostale. Another type of seaplane destined for similar services is that constructed by Lioré and Olivier, who exhibit two machines, one having a width along the plane of 38 m. and a length of 24 m. The total weight is 15 tons, and the paying load is said to be nearly 6½ tons. As is usual in the construction of such machines, the plane is carried across the top of the fuselage, and in the case of this particular seaplane there are cars on each side of the fuselage, each car having two engines with propellers fore and aft. In the event of one engine failing another may be cut out to run with two propellers, while repairs or adjustments can, it is said, be effected while the machine is in flight. There is a tendency to uniformity in constructional methods, with variety in the details of design and in the arrangement of engines. In one or two cases landing wheels are adapted to seaplanes, such as in the "Caudron," where the wheels are raised and lowered through floats. The attempts to encourage private touring in France have failed to prove so successful as had been anticipated, though a few clubs have been formed, and there are a few small machines on exhibition. Private touring does not seem likely to bring much work to aeroplane builders. Amongst foreign exhibits the Italians have a combined stand, and a characteristic machine is a monoplane built for a paying load of 3 tons with two cabins and fuselages separated by the pilot's cabin, the whole being built into the plane above, which has a length of 33 m. Above the plane are three Fiat engines developing a total of 2100 horse-power. The British industry is well represented with a Bristol machine and some Fairey aeroplanes, as well as engines by the Bristol Company, Rolls-Royce, and Armstrong-Siddeley.

The French have come round entirely to the all-metal aeroplane construction, with corrugated sheet riveted or spot welded. There are some novel ideas for strengthening planes, and the building of cabins to form part of the thick section planes has dispensed with the necessity of external wires and struts. In engines there is still about the same proportion of radial cylinder and straight types, in which the use of compressors is becoming more frequent. Lorraine has a nine-cylinder radial engine running on gas oil. It develops 250 horse-power at 1800 revolutions per minute and the weight is 320 kilos. This engine has been experimented with for two years past, and having satisfied the bench tests, it is now presented, as a final type, though we understand that it has not yet been fitted to an aeroplane. The Farman method of placing engines upside down in order to give a clear view to the pilot has appealed to an Italian firm which has a few of the smaller types of engines upside down on its stand. The arrangement necessitates special precautions for lubrication. In a general way there is a notable improvement in engine construction, and for this British engineers have set the example, their exhibits showing that they are still ahead of their foreign rivals. In France, the most successful radial cylinder engines have been built under British licence. The use of metal propellers has made a rapid stride this year, and there appear to be as many metal propellers on French machines as wood. With the steel alloys now available the weight has been got down to not much more than that of the wood propeller for a given power, while the margin of safety is, naturally, declared to be very much greater. There are now three French firms manufacturing steel propellers, including Gnome and Rhone. On some of the wood propellers the leading edges are sheathed with copper. The variable-pitch propeller is receiving more attention in view of its utility when flying at high altitudes. Some machines were fitted with the Paulhan-Pillard propeller, in which the pitch is varied mechanically by an arrangement of bevels, sectors, and levers. The Exhibition marks an improvement and, to a certain extent, a stabilisation in aircraft construction, in the sense that designing has followed the lines of machines that have proved most successful, and in this respect the French have been largely influenced by foreign progress. There are at present limitations to such progress, and the many failures in the past to strike out on new lines have shown that it is more prudent to make the most of the practical experience already acquired.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

OVER 100 PER CENT. EFFICIENCY.

SIR,—Mr. F. Llewellyn Smith, in your issue of November 4th, makes a comparison between a modified Brown, Boveri constant-pressure cycle and that of a hypothetic boiler in which the gases are precompressed, and in which the steam receives its heat at the temperature of the flue gases, whereas I compared the Velox boiler with an "ordinary" boiler where the gases are at atmospheric pressure and the steam temperatures are normal. I still hold that the Velox boiler, with the turbine driving the compressor, is capable of imparting more energy to the steam (by increasing the quantity of steam) than in an ordinary boiler of 100 per cent. heat efficiency.

It can be shown that, theoretically, it is better not to have the negative "heat pump" loop on the $\theta\varphi$ diagram, but to stop the cooling of the gas at the adiabatic $a\,b$, and employ an electric generator to absorb the surplus gas energy. But such a generator would be hardly worth while in practice, and the next best thing is to allow the gases to cool to a lower temperature (though well above the steam temperature) and utilise the above gas work to supply the work necessary for the negative heat-pump loop. Then, as in the Velox boiler, we get, theoretically at any rate, more steam energy than is obtainable from an ordinary boiler, assuming equal steam pressures and temperatures. This is the claim made by Brown, Boveri, and contested in your columns, which it is important to establish or refute.

Regarding Mr. Waring's last letter, I stated that, with the turbine in the final position, in the constant-pressure type, an efficiency of over 100 per cent. was probably unattainable in practice, but, theoretically, is so. The friction in the tubes does not enter into the theoretical thermo-dynamics. It is the question of the theoretical possibility of obtaining over 100 per cent. heat efficiency, accompanied by increased steam energy, which has been raised.

I would like to delete, from my letter, near the end, the sentence "and reduce the loss of available energy in the irreversible process of heat transfer," because as the $\theta\varphi$ diagram shows, the Velox gases, of temperatures $d\,e$, are hotter than the gas temperatures in an ordinary boiler. The greater available energy in the Velox steam is derived from the raising of the combustion temperature (as stated in my last paragraph), and is obtained in spite of the increased loss of available energy in the heat transfer process.

In ordinary boilers, even of 100 per cent. efficiency, there are two distinct losses of available energy, (*a*) the loss arising from the large temperature difference between the gas and steam, and (*b*) the loss due to the temperature of the gas not being the maximum possible. The Velox boiler diminishes loss (*b*) by raising the gas temperature by precompression and making use of this higher temperature in obtaining gas work. Loss (*a*) is increased by the Velox boiler, but this is more than compensated by the increased gas temperature.

In this connection one may further improve the definition of boiler efficiency by taking it as:

$$\frac{\text{Available energy in steam}}{\text{Available energy in fuel}}$$

where the denominator is the energy obtainable when combustion takes place at the highest possible temperature, *i.e.*, the temperature of dissociation of the products of combustion, and when there are no other losses.

London, November 17th. A. G. HINTON.

A REMARKABLE STEAM GENERATOR.

SIR,—My attention has been called to a description of "A Remarkable Steam Generator," in your issue of October 14th, 1932, page 390. Permit me to say that this kind of a steam generator is not only old, but it is a third of a century old, as it was used in a number of steam carriages built here in Lynn, Massachusetts, U.S.A., in the early days of this century, and which were used for a number of years. I have one such steam carriage in my possession at this time, the heating burner being one which used kerosene oil, and the arrangements being made automatic. It furnished steam at high pressure and high superheat, as desired. Water was admitted in at one end of a steam pipe bent back and forth, as is illustrated in the drawing in your article, and the steam was carried directly to the engine, which was a special kind of high-pressure, single-acting engine giving efficiencies even in a four-cylinder engine of not more than 7 or 8 horse-power, such that the consumption of water was about 17½ lb. per horse-power hour. It would be easy to furnish more details, if needed. My only hope, however, is to show that the scheme is an old one and that the only "remarkable" thing about it is that it should be resuscitated as a new invention.

I may refer to United States patent of Elihu Thomson, No. 735,683, of August 4th, 1903, which was filed in the United States Patent Office June 9th, 1898. I also desire to call attention to United States patent of Hermann Lemp entitled "Flash Boiler," No. 767,071, dated August 9th, 1904, and which was filed in the United States Patent Office, January 16th, 1901. Other references might be made, but these should be sufficient.

Lynn, Mass., November 9th. ELIHU THOMSON.

[We need not assure Professor Elihu Thomson that we knew of the motor car boiler to which he refers, and of several others of the single-tube or "flash" type, of which the Serpollet is one of the best known. But we still think that "Remarkable" was a fitting adjective to apply to a steam generator with a single tube of constant diameter no less than a mile and a-half long.—ED. THE E.]

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A 750-Ton Chain Testing Machine.

We recently inspected what is claimed to be the largest machine yet made for testing chain cables. It has been made by W. and T. Avery, Ltd., of Soho Foundry, Birmingham, for Lloyds British Testing Company, Ltd., and is to be installed in that company's proving station at Netherton, near Dudley, Staffs. It is capable of exerting and measuring, to a high degree of accuracy, a pull of 750 tons. That is to say, more than sufficient to test a chain cable such as is used on the largest of liners which are now in prospect. A stress of about 500 tons would be sufficient for most chains now in existence, for the Board of Trade requirements are that a 4½in. iron chain should withstand a breaking load of 306½ tons, and for cast steel chains of the same size, one of 428$^{8}/_{10}$ tons. The machine is also capable of testing anchors of corresponding size, besides wire hawsers, large pulley blocks, &c.

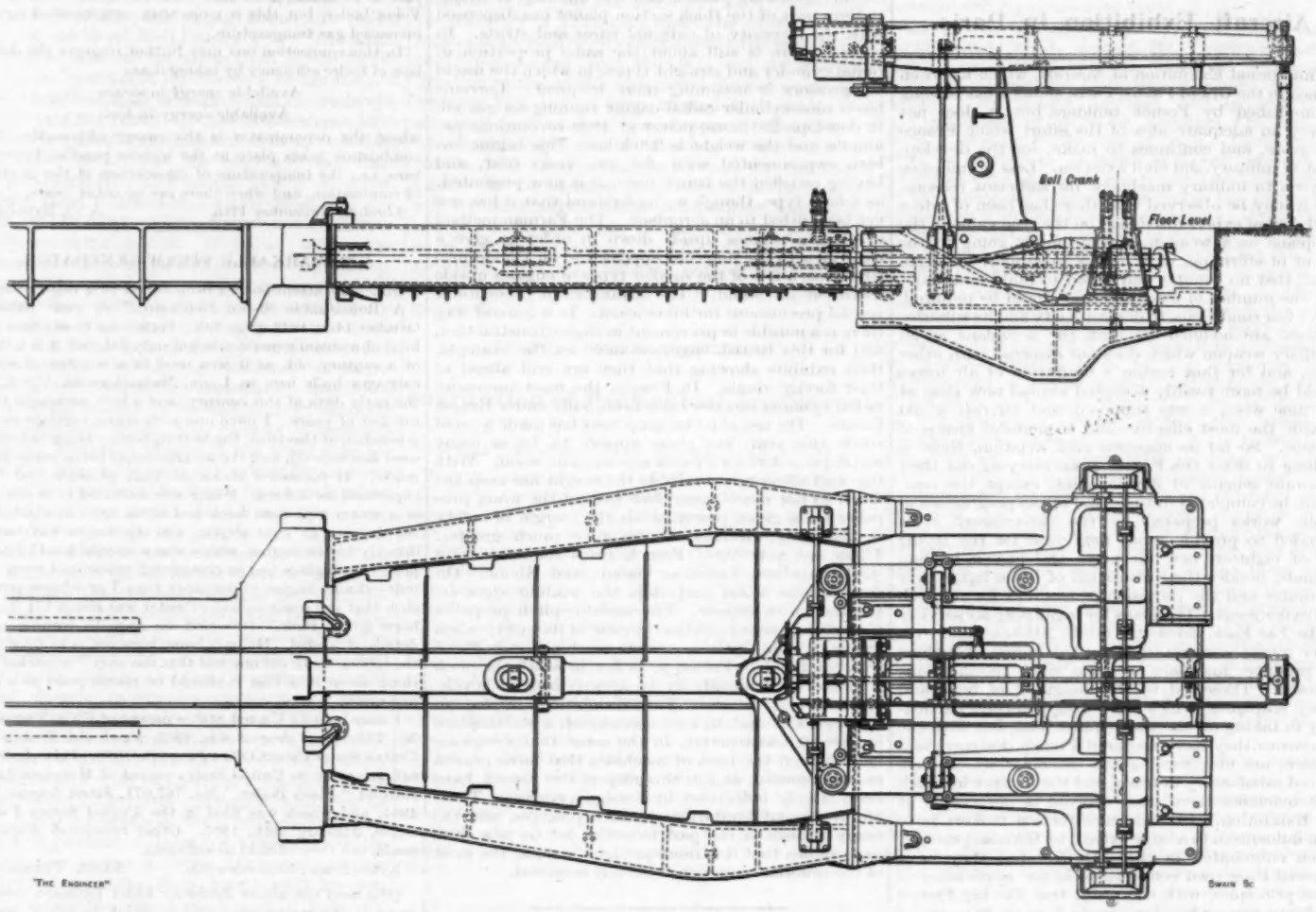
The degree of sensitiveness of this great machine may be gauged by the fact that during our visit, when a pull of over 200 tons was being exerted on a big chain, the addition of 8 oz. on the end of the weighing lever was plainly indicated. That 8 oz. represented about one-nine-thousandth part of the counterpoise used in the weighing.

The general principle of these chain-testing machines is probably familiar to many of our readers, but it may be as well here to give a brief outline of their construction.

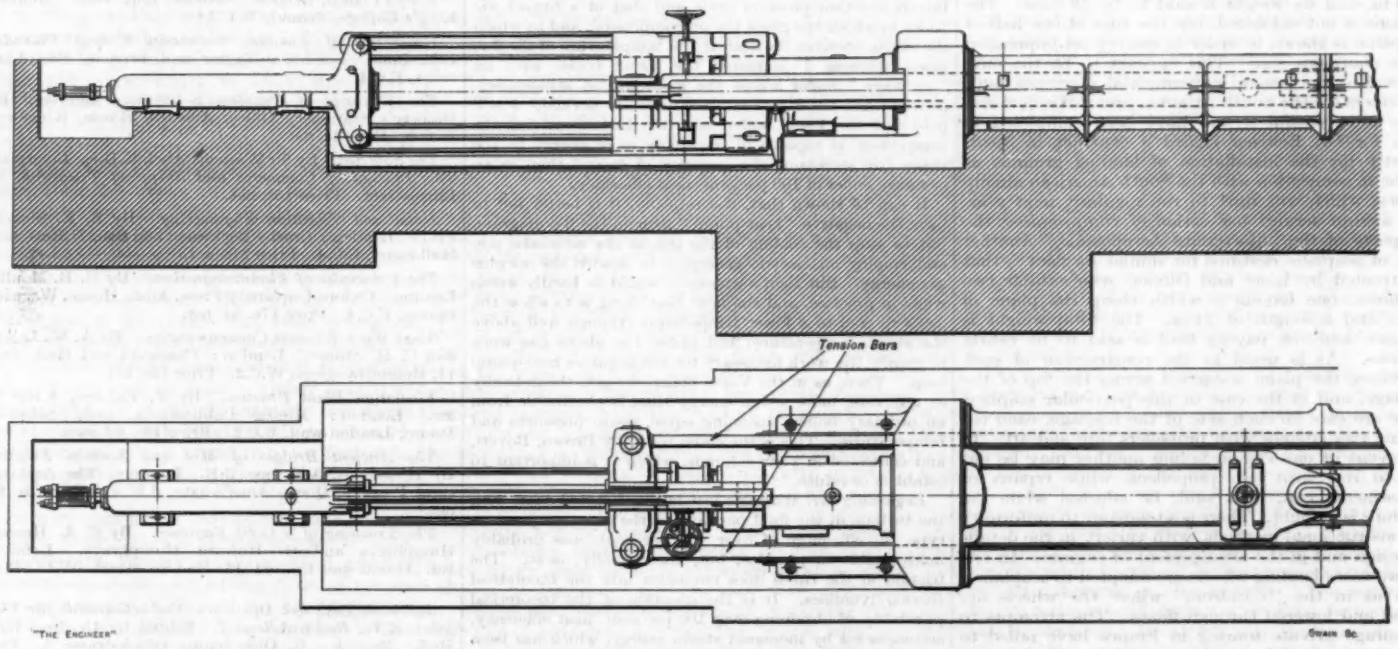
In the floor of the proving house there is embedded a very massive cast iron trough, which, in the case under review, is plainly shown in the engravings on page 538. This trough is sufficiently long to accommodate the regulation length of 15 fathoms (90ft.) of chain, and its top is set flush with the floor to facilitate the handling of the chain to be tested. The chain is laid in this trough and is gripped at both ends. One of the grips is in communication with the ram of a hydraulic cylinder that applies a tensile stress to the chain, getting its reaction against the trough, while the pull on the other grip is resisted by a system of weighted levers, which also press against the trough, in the opposite direction. The whole of the stress imposed on the chain is thus transmitted from end to end of the machine, a distance of some 150ft., through the trough, which must, consequently, be well founded. We understand that the foundations at Netherton will be 7ft. deep. Even then it is obvious that the machine must be well aligned to prevent buckling under load; but this has been assured by using a theodolite in the lining up process, and we believe that there is no part of the machine, throughout its overall length of 178ft. 6in., that is as much as five-thousandths of an inch out of line.

The erection of the machine was started at the weighing end, and we cannot help but congratulate Messrs. Avery on the possession of an erecting shop in which such a large machine, longer, we should judge, even than the 1250-ton universal machine for Dorman, Long and Co., which we described in our issue of July 30th, 1926, can be erected in its entirety.

We will start our description of the machine from that



WEIGHING END OF CHAIN TESTING MACHINE



GENERAL ARRANGEMENT OF STRAINING END

part is 13ft., and therein can be tested anchors up to 20 tons weight. The palms, in such a case, grip on to a heavy girder set between the arms in a pit 4ft. 6in. deep. When, however, chains are being tested, this pit is bridged over by steel plates at the floor level.

The testing trough is 4ft. 6in. wide, and is built up of six iron castings, each weighing about 10 tons. It is about 100ft. long, so that it will accommodate a 15 fathoms length of chain even when stretched to the limit. On the floor of the trough there are machined tracks for supporting the straining gear, while in the sides there are recesses for accommodating the pulling rods or tension bars for stressing the chain.

At the far end of the trough there is the hydraulic cylinder, with its ram pointing outward. This ram is 24in. in diameter, and presses against a crosshead attached to the tension bars just mentioned—they will be described later. In view of the fact that the machine will be seldom required to exert its full effort, a secondary ram, 12in. in diameter, works within the main ram and presses on its own crosshead. When it is desired to work the machine in its lower capacity, the main ram is locked in its innermost position by means of shear pins, or cotters, which enter two tie bars. (These tie bars, incidentally, hold the return stroke ram.) Then, on the admission of water to the back of the main ram, it finds its way through a hole in the base of that ram and pushes the secondary ram forward. For full power the main ram is unlocked and both work as one. An extension of the secondary ram, also of 12in. diameter, goes on to the return stroke cylinder at the extreme end of the machine. The stroke of both rams is 9ft., but the return stroke cylinder is slightly longer, so that there is a cushion of water to take up any recoil on the breaking of a specimen, the pressure developed in such a case being dissipated through a spring-loaded safety valve, which spills into a sump below. The rams have been treated with the Fescol process of electrically deposited nickel to prevent corrosion and make them run smoothly.

The pressure water supply to the several rams is controlled by a four-spindle valve stand of the interlocked type, which will be arranged on the observation stand at the steelyard, so that one man can perform a whole test. As shown in the engravings, however, this valve stand is at the ram end of the machine, as it was found more convenient for temporary erection.

STRAINING FIDDLES

The crosshead on the straining ram, which, by the way, is supported on a slide that also forms a base plate for the return ram, reaches horizontally across the width of the trough and is attached by pins to the two tension bars that run the length of the trough. These bars are built up of steel castings, about 4in. by 10in. in section and 10ft. long each. The joints between the pieces are made by means of a peculiar form of dovetail, which transmits the stress through pure shear, and these joints have been made with the most meticulous care, so that there is no backlash. It might almost be said that the whole length of the bar is one piece. At intervals of 3ft. the bars are bored, horizontally, with holes about 4in. in diameter to accommodate trunnions on the straining head. The bars were all bored in pairs to ensure that the holes are exactly opposite and the pull on the two sides equalised. The trunnions on the head can be retracted so that it can be moved along the trough and engaged with other holes in the bars to accommodate odd lengths of chain. In doing so the head runs on the machined tracks in the bottom of the trough, while the tension bars run on fixed ball bearing rollers.

The straining head has grips for the chain to be tested and has a corresponding head at the other end of the chain. This second head also runs on a ball bearing trolley, and the track runs right across the floor plates of the anchor pit when they are in place. For this reason the plates are carefully machined and spigoted together. Chain cables up to 100ft. length can be tested with the standard jaw and pin shackles embodied in the machine, but special holders of the form illustrated have been provided for testing chain up to 4¾in. diameter when 15 fathoms is the limit of length.

The tension in the chain is transmitted to the weighing steelyard in the following manner, which can best be followed with the aid of the detail line drawing:—The chain grip is attached to a central tension bar, at the end of which there is a heavy triangular steel casting, attached by means of a pin. This casting forms a yoke to transmit the pull to two tension bars, one on either side of the column of the weighing machine. These bars are continued to the end of the machine, where they actuate bell-crank levers. These levers are steel castings and have a ratio of 7½ to 1, with the short arm standing vertical. Their weight is carried by links from a bridge above, as they do not work on a journal pivot, which would introduce far too much friction. Instead, they bear against knife edges. These knife edges are square steel bars temperred and very carefully ground, and are 77in. long, so that they are not loaded beyond the 5 tons per lineal inch stipulated by the Board of Trade. They are held in V grooves in round bars, which, in turn, are embedded in the castings. It is thus possible to turn the knife edges should they become damaged, but we are assured by the makers that their experience shows that they will not need to be turned in a life-time. The knife edges bear against hardened steel plates attached to abutment castings at the end of the main base.

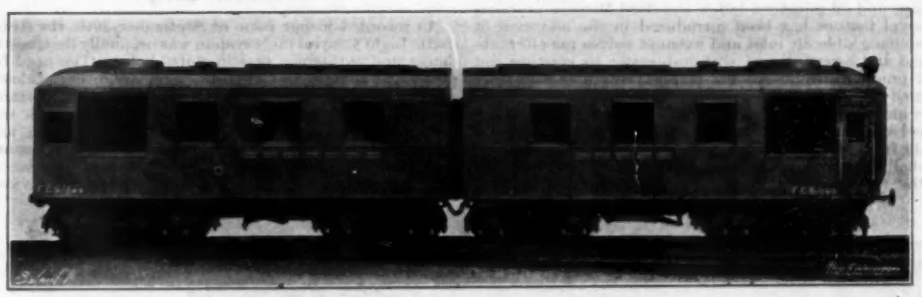
The side tension rods pass beyond the vertical arms of the bell-cranks, by means of bifurcations, made of steel plate, and are attached to castings carrying the upper set of knife edges, which are similar to those just described. It will thus be seen that the pull on the tension bars tends to depress the long, horizontal, arms of the bell cranks. A vertical force is thus obtained, which can be balanced by the steelyard.

At the ends of the long arms of the bell-cranks there are knife edges, which transmit the pull, through links, to a transverse yoke, and a central eye bar connects this yoke with the steelyard.

In the event of a specimen under test breaking the whole lever system naturally rebounds on the release of the stress, and, to prevent damage to the knife edges, buffers are arranged to take the recoil. They take the form of wooden blocks embedded in massive castings in the case of both ends of the bell-cranks, while the steelyard is buffered by means of springs.

The steelyard is built up of two steel plates cross-braced together and carries a counterpoise of 2 tons, which runs on ball bearing rollers and has a travel of 200in. It will thus be seen that the total leverage of the machine is 375 to 1. The counterpoise is made in two separable parts, the smaller being for loads up to 150 tons, while the two, combined, are used for full load tests. When the smaller weight is in use the larger one is locked at the end of the steelyard. The attachment of the two parts of the poise is effected by two hand wheels on the smaller part. This part also carries a vernier which traverses a scale with two sets of graduations, one for 750 tons, which can be read by means of the vernier to 1 cwt., and the other, for 150 tons, in increments of 28 lb. The counterpoise is moved along the steelyard by means of a screw, driven through bevel and spur gearing from a hand wheel on the column. Ball bearings are used and the weight can be moved easily and delicately. Just above the hand wheel there is a pointer connected with the steelyard, so that the operator can watch its swing without craning his neck to look up at the steelyard itself and follow the extension of the specimen under test.

The construction of this machine completes a trio of special high-capacity testing machines built by W. and T. Avery, Ltd., in recent years. The first was the universal testing machine, of 1250 tons capacity, used by Dorman, Long and Co., in connection with the construction of the Sydney Harbour Bridge, while the second was the 1,000,000 lb. vertical type testing machine made for the Department of Mines, Ontario, and now we have the 750-ton chain testing machine, in the design of which the co-operation of Mr. George Hatton, and of Mr. Henry Green, has helped to ensure that it is particularly suitable for the special purpose for which it is required.



1700 HORSE POWER MOBILE POWER HOUSE

Oil-Electric Locomotives.

A LARGE party of engineers and others interested in transport visited Newcastle on Monday last to witness a demonstration of oil-electric locomotives and motor coaches at the Scotswood Works of Armstrong, Whitworth. Four 1700 brake horse-power units that were on view are the largest of their type so far produced in Europe and have been built to the order of the Buenos Ayres Great Southern Railway, which has been running oil-electric trains for the past three years. One of the units is a double-purpose main line locomotive which weighs 148 tons, while the other three are 130-ton "mobile power-houses" which supply current to motors on their own axles and on the bogies of the train carriages, so that the train is propelled electrically in the well-known way. All the four units have a fuel capacity of 2¾ tons, which is sufficient for a 1000 miles' run with a heavy goods train.

Designed to attain a maximum speed of 70 miles per hour and for driving at either end, the "mobile power-house" units are each intended for use with eight 80ft. coaches with a seating capacity of 1000 passengers, equivalent to twelve or fourteen coaches on British railways. The gross weight is about 550 tons. As will be seen from the illustration, each unit is composed of two articulated parts each of which carries an 850 horse-power eight-cylinder oil generating set. Each generator supplies current to half the motors on the train, so in the event of one of the generating units failing the train can be run at reduced speed by the remaining set. The maximum acceleration of the train is automatically controlled so that the engines cannot be overloaded. The usual "dead man's handle" is fitted and safety devices are also provided to stop the engine in the event of failure of the lubricating or cooling systems.

The 1700 brake horse-power double-purpose main line locomotive is provided with two sets of motor gears, one for working with heavy goods trains in the harvest season and the other for fast passenger working speeds up to 70 miles per hour, the maximum tractive effort in the former case being 62,000 lb. at 4 to 1 adhesion. With its fuel the total weight of the engine is 148½ tons and the length over the buffers is 75ft. 3½in. While the engine is articulated in the same way as the "mobile power-houses," unlike the latter the bogies are equipped with six motors capable of absorbing the full power of the generating sets, which can be used singly if required. In the driver's compartments at each end of the locomotives the controls are duplicated on each side, and there are safety devices corresponding with those on the "mobile power-houses." All the generating equipment is interchangeable with that in the "mobile power-houses." Based on the results obtained with two 1200 brake horse-power oil-electric locomotives in service on the Buenos Ayres Great Southern Railway, the fuel costs for the "mobile power-houses" are expected to be considerably less than half those of steam. The oil-electric trains on this railway run a distance of 14 miles with eleven stops and the average fuel consumption per train mile is 9·4 lb. or a fuel cost of 4¼d. per train mile, as compared with a steam locomotive cost of 11d. per train mile.

A multiple-unit oil-electric motor coach train was employed to convey the visitors from the Newcastle Central Station to Scotswood. While retaining all the advantages of ordinary railway electrification, trains of this type are, of course, capable of running anywhere without expensive conductor rails and sub-stations. The oil-electric system can therefore be applied to inter-urban shuttle services of high or low density and under many other circumstances. The heavier multiple-unit train is exemplified by the Buenos Ayres Great Southern Railway trains, where the oil power equipment is carried in a separate "mobile power-house" supplying power to motors on the coach bogies in the manner described, but for lighter trains calling for power up to 600 brake horse-power the operating equipment is carried on the motor coaches. A train consisting of two, three, or four coaches, including the motor coach, may suffice during off peak hours, whilst for rush hours two or more such train sets are coupled together and both power equipments are worked from the leading driver's compartment by one man, when the same acceleration and point-to-point timing are obtained as with the single set. Additional trailer coaches may, of course, be inserted between sets.

The two motor coaches used in the demonstration—the "Lady Hamilton" and the "Northumbrian"—are each equipped with a 250 brake horse-power Armstrong-Sulzer engine. There are two driving compartments and seating accommodation for sixty passengers. The maximum designed speed is 65 miles per hour. On October 8th the Armstrong-Whitworth oil-electric motor train "Tyneside Venturer" completed six months' continuous service on the London and North-Eastern Railway Company's intense local services around Newcastle. During that time the train worked seventeen hours daily, ran 25,000 miles, and kept its time schedule without one minute's delay. The total fuel and lubricating oil costs for the whole period amounted to only £87, or less than three farthings a mile. Oil-electric shunting locomotives were also on view and figures were produced to show the remarkably low cost of operation. After the oil-electric locomotive and motor coach shops had been inspected and a visit had been paid to the Armstrong-Saurer commercial vehicle works, luncheon was served at the Central Station Hotel, where a number of prominent people, including the Right Hon. Walter Runciman, assembled. Speaking on the merits of the oil-electric system, Lieut.-Col. P. D. Ionides said that a great drawback to complete electrification was that, having adopted a given system, departure from it was almost impossible, notwithstanding any improvements that might be introduced in subsequent years. The oil-electric system, on the other hand, while offering the benefits of ordinary electrification, also permitted the adoption of all improvements as they came along without stultifying what had been done before. Mr. Trutch had shown that all the railways could be equipped on the oil-electric system for about half the capital cost required to carry out the Weir Committee's scheme and saving nearly £23,000,000 per annum, or 43 per cent. of the present steam working costs, thereby giving a return of 17 per cent. on that capital, as against the 6 per cent. on the Weir scheme. It had been remarked that as a coal-producing country Britain could never run its railways on oil. But had the supply of coal in this country prevented the building and use of oil engines for marine propulsion or prevented the use of oil for raising steam in great steam liners or in the British Navy? Moreover, once the practice of burning smokeless fuel was adopted there would automatically be a supply of home-produced oil quite apart from the success which appeared to be likely to attend the efforts that were being made by Imperial Chemical Industries to hydrogenate coal.

THE MOTOR TUG "CROWSTONE"

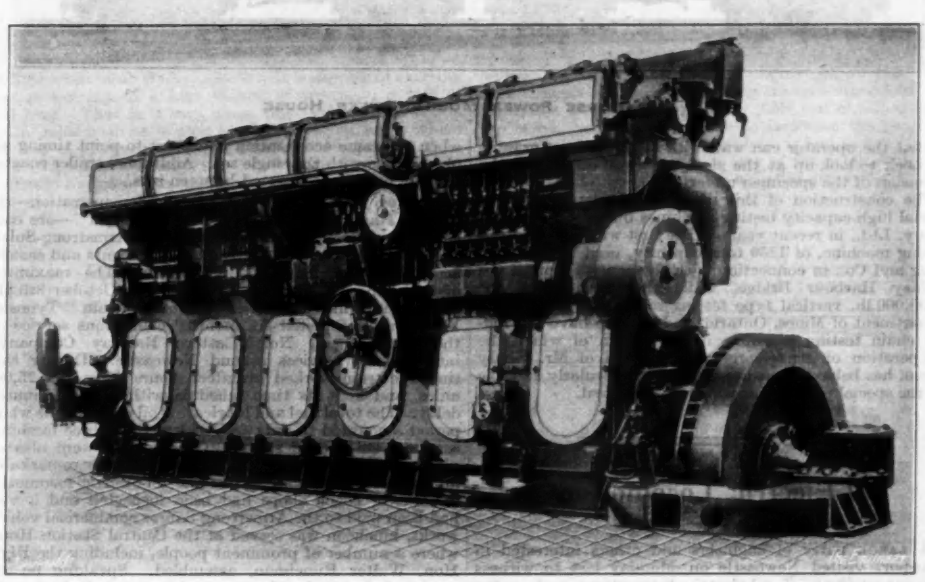
The Thames Motor Tug Crowstone.

In the engraving above we illustrate the Thames motor tug "Crowstone," which has been built by James Pollock, Sons and Co., Ltd., of Faversham, and 3, Lloyd's-avenue, E.C.3, and engined by Mirrlees, Bickerton and Day, Ltd., of Hazel Grove, near Stockport, for the service of the General Wharfage and Supply Company, Ltd., of Erith. We were recently invited to make a trip on the tug and noted for ourselves the excellent manœuvring capabilities of the engine, which is a new design specially built for marine work. It has a rated output of 275 B.H.P. at 225 r.p.m., the cylinder diameter being 12½in. and the stroke 19in. It operates on the four-stroke principle with airless injection. While the principal running parts, with the exception of the Bosch fuel pumps and oil injectors, follow standard Mirrlees practice, a novel feature has been introduced in the adoption of interchangeable air inlet and exhaust valves for alternate ahead and astern duties, with automatic air starting and fuel pump control. All the manœuvring operations are carried out by means of a single hand wheel and one lever. The illustration below shows that the manœuvring hand wheel and the fuel pump and governor controls are arranged at the front of the engine. The extended bed-plate carries a Michell thrust block, while at the opposite end of the engine is the two-stage 350 lb. air compressor for the starting and manœuvring air, and the bilge and water circulating pumps. A small Gardner standby compressor set also forms part of the installation.

The light running trials took place between Erith and Tilbury and were of about four hours' duration. Speed tests were made by timing the tug over a measured mile, with the engine running at normal full speed, twice with and twice against the tide. The average of the four readings was 10¼ knots. Extended manœuvring tests were also carried out and during these trials the engine responded perfectly to the rapidly changing orders given from the bridge. The time taken to change from full speed ahead to full speed astern of the engine was ascertained to be five seconds. The fuel consumption of the engine, which was checked whilst running at constant speed over a given period, worked out at 0·372 lb. per B.H.P. hour. The towing trials were made at Erith and five barges carrying a total load of 1250 tons were taken in tow against the tide. With the engine running at 257 r.p.m. the tug slightly more than held its own against the tide, and great satisfaction with this performance was expressed by her owners.

The normal load, we are informed, which the tug will be called upon to haul in service is about 800 tons, so that the trial performance demonstrated that the engine has an ample reserve of power.

One of the barges was later detached and the remainder of the trials were carried out with a total load of 1040 tons. Throughout the whole period of both trials the engine exhaust was practically invisible, and the amount of starting air used by the engine was quite small, there being no necessity to use the auxiliary compressor at any time during the trials.



275 B.H.P. OIL ENGINE FOR TUG "CROWSTONE"

Fire Detection and Extinguishing Aboard Ship.

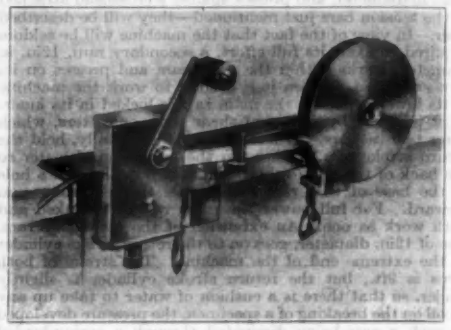
As recorded in our issue of September 30th, the Automatic Light Control Co.'s system was originally designed to detect and extinguish fires in ships' holds. The need for protection against fires in state-rooms and other enclosed spaces on board ship, however, is also highly important, and it has now been met by a new system, which will give audible and visible warning against fires in any individual state-rooms. In order to avoid unnecessary multiplication of indicators, the following system is adopted for use in individual cabins. The ship is divided into any convenient number of sections, for each of which is provided a signal lamp and a selector dial. There is also an audible alarm which is common to all the sections. In the event of a fire in any section, the audible alarm is operated and the signal lamp corresponding to that section goes out. It is then only necessary to turn the knob of the corresponding selector to find the exact location of the fire. If desired, the signal lamps and the audible alarm may be located on the bridge, and the selector dials may be placed at suitable fire stations located in different parts of the ship. This leads to economy in wiring, since the individual fire stations can be connected to the central indicator by a single wire.

This new development provides, it is claimed, a positive and simple system in which the cost of installaton per room will be relatively small.

Engineering Marketing Services, of 110, Fenchurch-street, E.C.3, are perfecting a combination of the system described above with a method of sprinkler extinguishing for the state-rooms, which it is claimed will render a ship so protected as proof against fire as human skill and ingenuity can make her.

The "Protector" Binding Machine.

We have had brought to our notice by B. J. Hall and Co., Ltd., of Stourton House, Dacre-street, London, the neat binding machine illustrated by the accompanying engraving. One of the difficulties encountered in storing and using frequently required tracings and paper drawings is that they become torn and damaged at the edges. These tears may spread until the condition of the drawing becomes so bad as to necessitate the making of another. The little machine illustrated protects the edges of the drawing by applying a special linen tape and folding it around the edge. It binds under pressure without heat or paste, and the makers claim that all the edges of a double elephant size drawing can be protected in two minutes. In use, the machine is clamped to the edge of the table by the operation of two thumb screws, a roll of tape is placed in the container, and its end, creased for 2in. or 3in., is led behind the guide plates and between two milled wheels. The machine is then ready for use, and the edge of the drawing is fed between the guide plates and gripped by the milled wheels, when the hand wheel is rotated. Thus the tape is folded and attached to the edges of the drawing.



EDGE BINDING MACHINE

72in. Centres High-Speed Roughing Lathe.

The powerful lathe illustrated at the top of the next page was built by Craven Brothers (Manchester), Ltd., Reddish, Stockport, to make the maximum use of high-speed steel and alloy cutting tools, and is distinguished by its wide range of speeds, rigidity under heavy duty, and general facility of control.

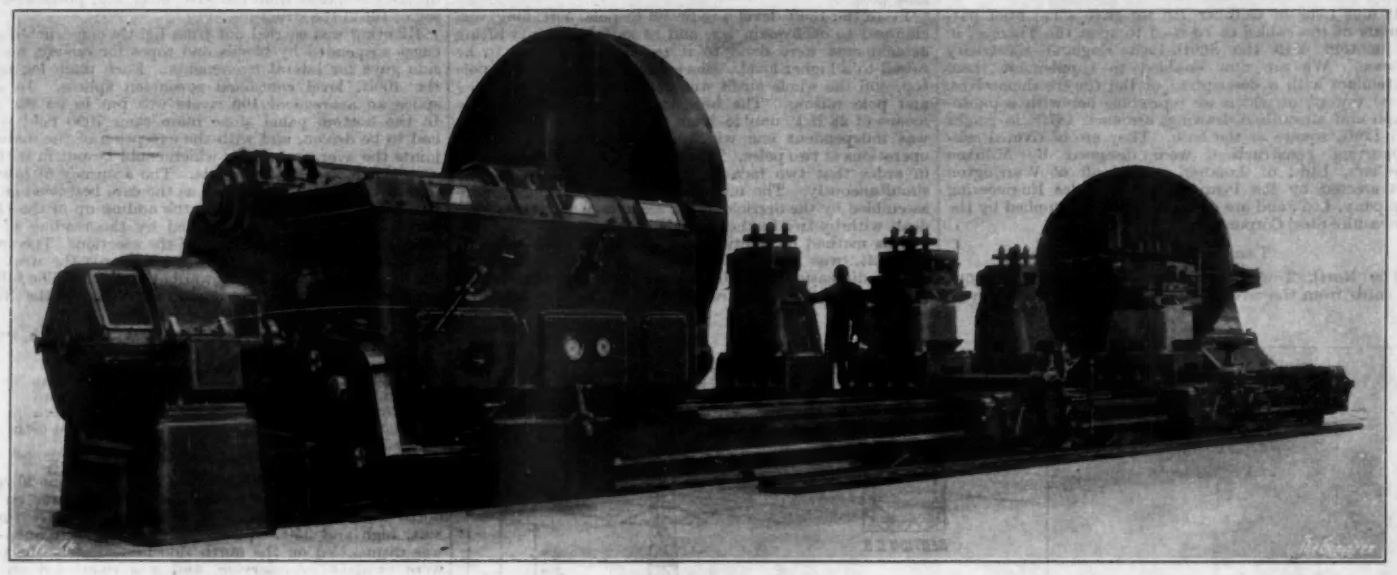
The bed is of the four-shear pattern, with square section ways. Owing to its unusually large size it is made in four sections, two in the width, 11ft. 9in., and two in the length, 57ft. 6in. The sections are accurately jointed and positively located by transverse keys and fitted bolts, and the surfaces of the ways are cast specially dense to resist wear. A machine-cut steel rack is bolted to both the front and rear of the bed for the power motions of the saddles and loose headstock. The fast headstock is totally enclosed and the spindle is carried in parallel bearings. All the gearing is of high-tensile steel and is mounted on auxiliary shafts of large diameter.

Ready means are provided for obtaining the various speed ratios ranging from 0·4 to 10 revolutions per minute, the change speed levers being carried on the front of the headstock. For the lubrication of the revolving parts a cascade oiling system is incorporated in the headstock, and by this means the gear wheels receive a continuous flow of oil at the points of engagement of the teeth. The oil supply is provided by a small motor-driven pump, which is started or stopped in synchronism with the main driving motor. Another small pump driven by the same motor as that for the cascade system and drawing its lubricant from the same tank lubricates the spindle and auxiliary shaft bearings, the oil passing through a Tecalemit filter and pressure gauge. With the exception of the pumps and tank, all the parts of the lubricating system are enclosed in the headstock, and the oil for both circuits is filtered before re-entering the tank after use.

The headstock is fitted with a built-in tachometer and ammeter, while electrically lit inspection windows enable the interior of the headstock to be inspected while the lathe is in operation. As is customary, all the change speed motions are interlocked to prevent damage by simultaneous engagement of two different speeds. The spindle, 24in. diameter at the front neck, is of forged steel with a solid spigot and flange for locating and securing the face-plate. It revolves in parallel capped bearings of special bronze and the end thrust is taken by a multiple collar bearing. The face-plate is of cast iron and has four strong steel jaw slides carrying heat-treated steel jaws, which are adjustable by screw and ratchet lever. The jaw slides are easily moved in machined tee slots on the face-plate and are fitted with pins and bolts for securing them in the desired position on the face-plate. The face-plate is driven by a large spur gear ring of 40-ton steel bolted on its rear face and driven by a nickel-chrome pinion arranged with a rigid support on both sides to minimise noise and vibration when making heavy cuts.

The lathe is driven by a variable-speed 80–150 H.P. motor mounted on a base-plate at the end of the bed and driving direct the high-speed shaft through a Bibby flexible coupling. There are four saddles, two at the front and two at the rear of the bed. Each front saddle is fitted with a compound slide rest with an adjustable swivel slide which may be set to any angle, and the top two slides are adjustable transversely by hand—an arrangement which enables the operator to set the tool without leaving the work. In addition, the tool slide is given longitudinal power motion on the swivel slide so that short tapers can be turned. Each back saddle is fitted with a rest of the

72-INCH CENTRES HIGH-SPEED ROUGHING LATHE



non-swivelling type, the slide being specially designed to resist the heavy stresses when back cutting. All slides are provided with self-acting surfacing motions by screw and nut, self-acting sliding motion by rack and pinion, and hand and quick power traverse along the bed, the latter being operated by means of separate and independent flange mounted motors, one on each saddle.

The longitudinal feed shafts, one at the front and one at the rear of the bed, have self-acting tumbler bearings. The feed gearing is arranged in the saddle aprons and gives a wide range of feeds necessary for both rough and finish turning, each saddle having six reversible feeds for both sliding and surfacing. These feeds are interlocked and are fitted with safety clutches. The power traverse for each saddle is effected by a flange mounted motor with push button control, so that the operator may treat each saddle as an entirely separate unit.

The loose headstock has a wide base and is of heavy construction. It has a four-jaw chuck mounted on a revolving steel spindle which is carried in parallel capped bearings in the headstock. The revolving spindle carries an inner barrel, which is bored to receive a cone centre, this barrel being adjustable lengthwise by hand wheel and screw. The loose headstock is mounted on an intermediate plate and has transverse adjustments for parallel or slightly taper turning. Hand and quick power traverse on the bed are provided, the power motion being operated by a separate flange-mounted motor. The lathe is controlled by automatic push buttons, a push button station being mounted on each saddle and on the fast headstock. The front saddle controls have buttons marked "Stop," "Start," "Inch," "Accelerate," and "Retard," for the main motor, and "Forward" and "Reverse" for the quick traverse motor. The back saddles carry three buttons marked "Stop" for the main motor and "Forward" and "Reverse" for the quick traverse motor. The fast headstock carries five buttons marked "Stop," "Start," "Inch," "Accelerate," and "Retard," for controlling the main motor.

Wherever possible mechanical lubrication is fitted, and where it has been found inconvenient one-shot pumps are fitted, or in the case of isolated bearings oil gun nipples. The following are the principal dimensions of the lathe :—

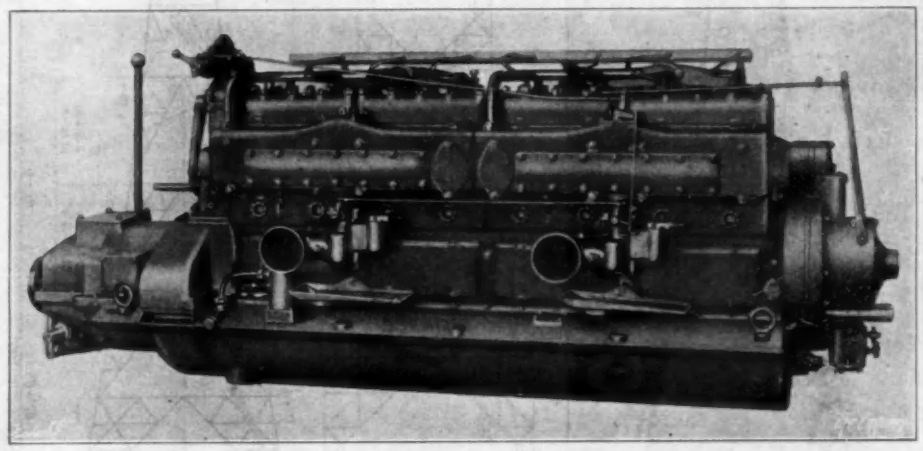
Height of centres	72in.
Length of bed	57ft. 6in.
Width of bed	11ft. 9in.
Will admit between centres	33ft. 6in.
Will swing over saddles	120in.
Diameter of spindle front neck	24in.
Diameter of face-plate	12ft.
Diameter of loose headstock revolving spindle	22in.
Diameter of four-jaw chuck	10ft. 6in.
Range of spindle speeds	0·4 to 10 r.p.m.
Number of sliding feeds	8ix
Number of surfacing feeds	8ix
H.P. of main driving motor	80/150
Approximate weight, not including electrical equipment	174 tons

A 160 B.H.P. Marine Oil Engine.

WE illustrate herewith a new eight-cylinder oil engine, designed and built by the Parsons Oil Engine Company, Ltd., of Town Quay Works, Southampton. It is a very flexible unit, and is designed for a very wide range of speed, from 900 to 1800 r.p.m., the maximum horse-power being 160 B.H.P. As is usual with Parsons engines, this unit is made in both petrol and paraffin types. The engine is clean in its general outline, and makes a very neat installation, as the reverse gear has been very neatly disposed and carefully tapered away for this purpose.

The crank case feet, which extend from end to end of the engine and well on to the reverse gear, are hollow, one side being used as a water jacket for cooling the oil as it flows over the inner surface of the crank chamber, and the other side as an oil reservoir under pressure, supplying the clean cool filtered oil direct to the bearings. Two carburetters are fitted to the petrol engine, and dual vaporising systems to the paraffin engine. Both types are governed, and the governor can be set to cut out at any predetermined speed. All the standard features are maintained, including a double-acting bronze plunger circulating water pump, forced lubrication to all bearings through drilled ducts in the crank chamber casting, and the absence of any oil pipes inside the engine. The magneto is provided with an impulse starter, and a very neat form of raised starting gear is fitted on the after end, this being of the standard Parsons type.

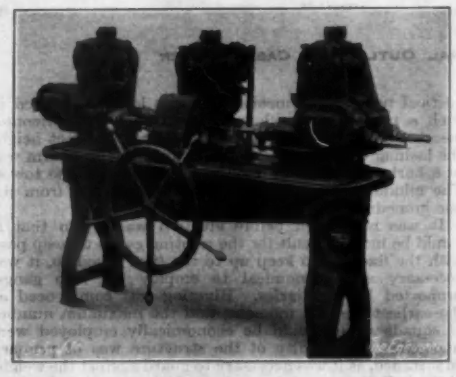
A noteworthy feature is the provision made for auxiliary drives. At the forward end there can be fitted a bilge pump, a tachometer, a fuel pump, and an additional magneto, if required, while other auxiliaries can be operated from these drives, according to the lay-out of the plant. The crank shaft is extended at the forward end at its full diameter, so that the whole of the engine power may be transmitted, if necessary, to a winch, air compressor, dynamo, or other apparatus. The weight is 2800 lb. in cast iron, or 2000 lb. when built in aluminium alloy. The engine illustrated has been designed for an express cruiser, and a number of similar units are under construction for overseas orders.



EIGHT CYLINDER 160 B.H.P. MARINE OIL ENGINE

Four-Spindle Drilling Machine.

THE photograph reproduced on this page represents a four-spindle horizontal drilling machine recently designed by Jones and Shipman, Ltd., of Leicester, for the accurate drilling of long holes of small diameter on a mass-production basis. The tool has an independent motor drive to the two opposed spindle drill heads and an independent drive to the double workhead in the centre of the machine. One of the main features of the machine is a special collet locking arrangement, by which one movement of the tommy bar is sufficient to open the double collet holding the work to allow for its removal, and a similar movement in the reverse direction locks the new piece in position. When it is pulled forward for loading purposes, the workholder is automatically stopped by a brake arrangement on the hand wheel at the back. The two drill spindles on the left-hand end of the machine are fed with an automatic trip motion, which can be adjusted to any length within its capacity, and the two spindles on the right-hand end of the machine are set to carry on to finish the hole after the return of the two left-hand spindles has taken place. The two right-hand spindles are controlled by the capstan hand wheel in front of the machine. The simultaneous feed of the four spindles is sensitive, and allows the operator to feel the cut of the drill. As both drill spindle and work revolve against each other, a high degree of accuracy and concentricity is attained. We are informed by the makers that this machine drilled holes 6¼in. long, approximately ⅛in. diameter in two pieces at one setting, and the floor to floor time was sixty pieces per hour. The material was a very tough high-tensile steel.



FOUR-SPINDLE DRILLING MACHINE

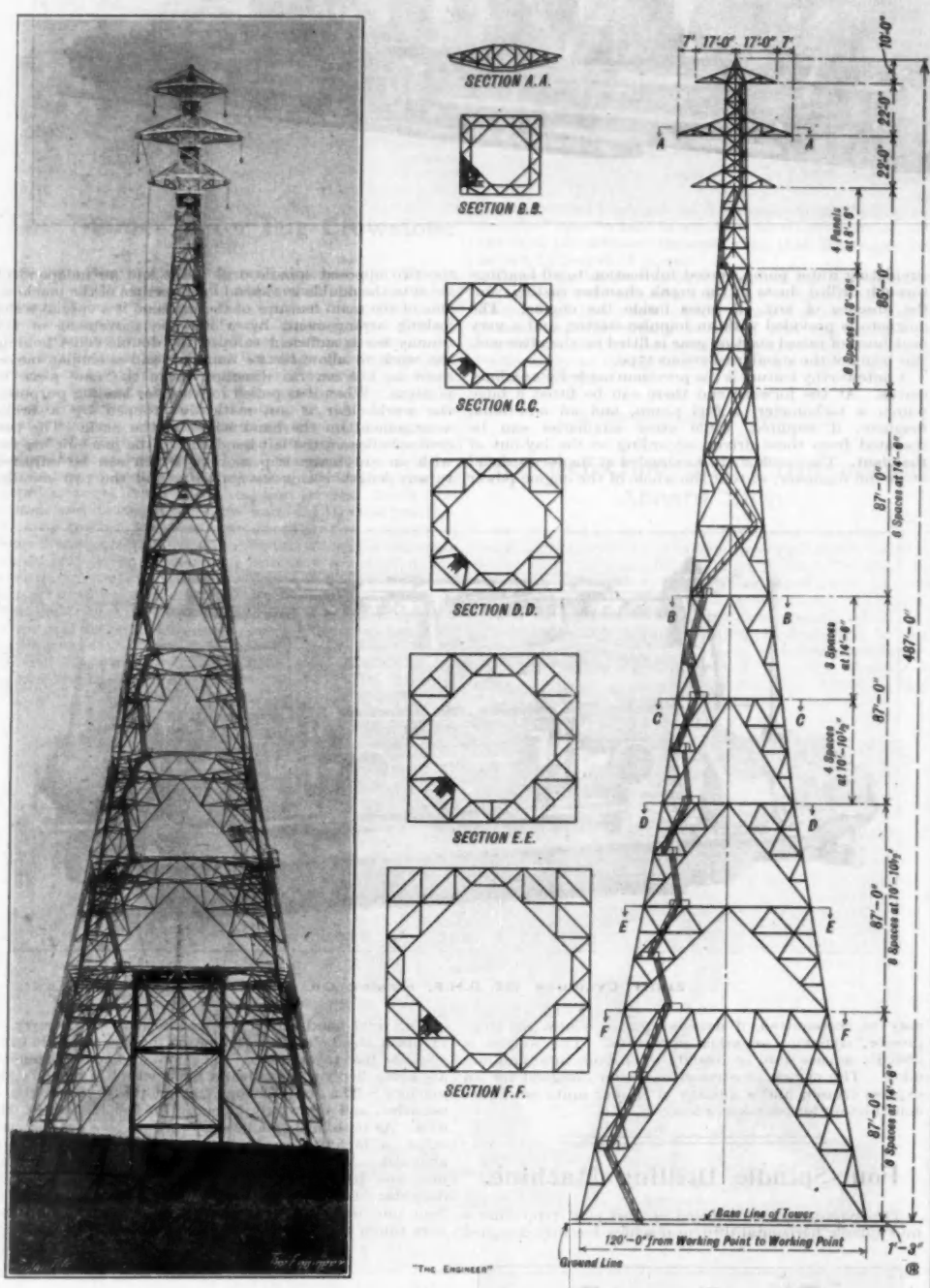
FOUNDED to assist the Management Research Groups, which are composed of industrial concerns' study circles, the Management Library, 23, Bloomsbury-square, London, W.C.1, is now open to general membership. The library contains works on general business, industrial, factory, and office organisation and management. Books on rationalisation at home and abroad, waste elimination, standardisation and simplification, cartels, combines and amalgamations, marketing, selling, retailing, transport, *personnel* and fatigue, wages and pensions and welfare, are available for borrowing, as well as volumes on subjects such as production, management, company secretarial work and general and cost accounting, and statistical methods and budgetary control in manufacturing, distribution, business management, &c. There are, in addition, a biographical section and sections embracing works on psychology, education, economics, labour theories, and credit and finance. Numerous periodicals are available in bound volumes. All British and American books on business published are recorded by the library, those of possible value are examined and those of definite value purchased, a short review of these last being sent to all members. The library is available either for loan of books or for reference purposes to companies, individual business men or business students.

Towers for the River Thames Cable Crossing.

In our issue of October 7th we gave some brief particulars of the cables to be used to span the Thames, in conjunction with the South-East England Electricity Scheme. We are now enabled to supplement these particulars with a description of the towers themselves. These towers, of which we reproduce herewith a photograph and an outline drawing, are each 487ft. in height and 120ft. square at the base. They are of riveted self-supporting construction, were designed by Milliken Brothers, Ltd., of London, were built at Warrington and erected by the Pearson and Knowles Engineering Company, Ltd., and are composed of steel supplied by the Lancashire Steel Corporation, Ltd.

The North Tower.

The North Tower is situated at Dagenham, about 50 yards from the river Thames, and stands on a square base with the cardinal points 120ft. apart. The peak of the tower is 487ft. above the base line, and this height is spaced into six panels, the lower four divisions being each 87ft. high, the fifth 85ft., and the top panel 54ft. high. A stairway is provided up to the 348ft. level, the remainder of the tower being ascended by ladders. Provision is also made for a lift.



General View and Constructional Outline of Cable Tower

The junction of the four main legs could be made only at the top of the first panel level, and at this point they were 85ft. square, each leg having a cant towards the centre of 17ft. 6in. from the vertical. The method adopted to effect this junction was to erect a temporary joist tower, 89ft. high by 35ft. square, on which was mounted a circular rail track, 3ft. 6in. gauge by 14ft. radius. Three steel carriages, carrying a 3-ton derrick crane, with a 55ft. jib, enabled the erectors to reach a point 130ft. above the base level. At each corner of the temporary trestle outriggers were fixed, and at the ends of the latter 1¼in. adjusting screws were attached, and dealt in a speedy manner with any slight irregularities in the squareness of the main legs. It was then possible to fix the vertical and horizontal bracings, while the 85ft. horizontal members connecting the main legs were held up free from sag by the derrick crane. The derrick crane was driven by a 28 H.P. motor hoist mounted on a frame attached to the king post.

From the 130ft. level a redwood fir pole, 55ft. long, was clamped to each main leg, and at suitable points lifting attachments were fixed to it to enable the pole to be raised to a higher level. Blocks were slung from the pole top, and the whole outfit was designed for speedy lifting and pole raising. The hoisting was again effected by means of 28 H.P. double-drum motors, and as each drum was independent one winch man could attend to the operations at two poles. Two gangs of men were employed in order that two faces of the tower could be erected simultaneously. The main legs and main bracings were assembled by the derrick gangs, secondary members being dealt with by two further squads of men.

This method of erection was continued until a height of 400ft. was reached, at which level the horizontal square dimension is 12ft. Two derricks were then discarded. The top cross arm during hoisting was held in a vertical position by means of a wire lashing, secured in such a manner that when the centre of the horizontal member was hoisted to approximately its correct height the lashing could be slackened off until the cross arm was in a horizontal position ready to be bolted to the tower. The middle and lower cross arms were erected from the one immediately above.

It was recognised before erection was begun that it would be most difficult for the riveting gangs to keep pace with the fixers. To keep up to the time schedule, it was necessary and economical to employ two top gangs, supported by auxiliaries. Riveting was commenced at the earliest possible moment, and the maximum number of squads which could be economically employed were engaged. The rigidity of the structure was of primary importance, as it was necessary to guard against the weight of the bolted portion above that which was riveted taking up the clearance in the holes above the bolt diameter. It was desired not to have a gap of above 150ft. between the fixers and the riveters, but the isolated positions of the joints and the small number of rivets which could be put in without removing staging and cages made the gap at one period 220ft. This condition had been foreseen, however, and to meet it the erectors filled up 75 per cent. of the holes with bolts and a number of drifts, which took up the clearances from the 87ft. level, and prevented any sag or tilt in the structure.

Riveting was carried out from lightly constructed steel cages suspended by blocks and ropes for raising, and by side guys for lateral movements. Each main leg up to the 400ft. level contained seventeen splices. In each splice an average of 100 rivets was put in on the site. In the bottom panel alone more than 7000 field rivets had to be driven, and with the exception of the main leg joints the average number which could be put in without a stoppage was sixteen rivets. The accuracy of fabrication in the workshops as well as the care bestowed on the base levels and on preventing the adding up of the clearances in the holes was revealed by the reading of the theodolite on the completion of the erection. The transverse face, it was found, was 1in. towards the west and the longitudinal face ⅛in. towards the south. The following dates record the progress of the work on the North Tower :—

Commenced erection	April 25th, 1932
First panel, 87ft. high, finished	May 7th
Second panel, 174ft. high	June 4th
Third panel, 261ft. high	June 29th
Fourth panel, 348ft. high	July 19th
Fifth panel, 400ft. high	July 30th
Sixth panel, peak	August 30th

The South Tower.

The South Tower is situated at Crossness, about 20 yards from the river, and is a duplicate of the tower on the north side of the river. The temporary joist tower, 89ft. high and 35ft. square, with its derrick crane, &c., was dismantled on the north side immediately the poles were brought into service, and was re-erected on the Woolwich site. The method of erecting was similar to that adopted for the north tower, but with the experience gained the erection was completed in a more speedy manner.

In accordance with regulations in force at the site, all naked lights were strictly prohibited. Rivets, as a consequence, had to be electrically heated. Heavy cables were necessary for this purpose, and care had to be exercised to prevent their being chafed and damaged by material being hoisted to a higher level than that at which the riveters were working.

Two double-headed rivet heaters were used, and as their weight was fully seven times greater than the coke-fired heaters, additional staging was necessary and mobility was very much reduced. Two squads of riveters had to be supplied with rivets from one machine, the rivet heater dropping the heated rivet in a pipe which led to the holders'-up cage. These restrictions increased the gap between the erectors and the riveters, and ten days elapsed at times after the erectors had finished before the riveting was completed. Much thought had been given to this question, as owing to the expensive nature of the machines two squads had to work closer together than ordinarily. As overtime work did not produce the desired result, double shifts were tried for a week, but the weekly progress graph proved that this method was economically unsound. By that time riveting had been completed on the north tower, and the whole of the tackle, with the exception of the fires, was transhipped to the south tower. Cages and staging could then be fixed in advance of the riveters' requirements, and as a result progress showed an improvement of 50 per cent. in the first week. The following dates record the progress of the work on the South Tower :—

Commenced erecting	June 20th, 1932
First panel, 87ft. high, finished	June 30th
Second panel, 174ft. high	July 18th
Third panel, 261ft. high	August 4th
Fourth panel, 348ft. high	August 11th
Fifth panel, 433ft. high	August 20th
Peak	September 2nd
Riveting completed	September 10th

General Details.

The main legs of the towers at the base are composed of 8in. by 8in. by ½in. angles in cruciform make-up. The towers are riveted and painted up to a height of 400ft., and beyond that level up to the top they are galvanised and bolted. The fabrication of the towers in the shops was a task calling for very great accuracy. Both towers were produced from the same templates. In order to check the workmanship, one corner of each tower was erected throughout in the shops, as also was the whole of the top structure. Each tower weighs about 300 tons and comprises 17,000 pieces of structural steel, 35,000 rivets, and 7000 bolts, a total of 59,000 pieces per tower.

TRADE EXCHANGES.

The method of exchanging manufactured goods and produce between countries that are unable to trade normally seemed likely to develop in the early stage of the economic crisis, and though it has not proved satisfactory in all cases, it has nevertheless continued to a certain extent, for the reason that without barter it would be impossible for some countries to do business at all. An arrangement has been come to, for example, whereby Germany will supply railway material to Bulgaria in exchange for produce, principally tobacco. The representatives of France and Poland have protested to the Bulgarian Government against this arrangement, the French declaring that as France buys large quantities of tobacco from Bulgaria she is entitled to supply some of the railway requirements of that country. As regards Poland, an arrangement for "compensated exchanges" was recently entered into with Holland. Poland has received orders for the supply of rails and accessories and water mains for the Dutch East Indies, and the value of those orders will be balanced by imports from Holland. All this tends towards an equality of exchanges, which constitutes the basis of plans that are being set up for a general economic adjustment. In this country a scheme has been proposed, as an emergency measure, by the London

Chamber of Commerce. It is known as the "Bartex," and under it transactions would be effected through the respective central banks by means of barter units, whose values would be fixed between any two trading countries and which would be negotiable only between those countries. The unit would be called a "Bartex."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Making Progress.

INDUSTRY in nearly all its branches in the Midlands and Staffordshire has been very sick, but it can now with confidence be reported that the patient is making steady progress towards what is hoped will be a full recovery. Indeed, keen disappointment will be felt if in a few months hence we are not able to visualise Midland industry as once more well on the road to robust health. Of course, it will take some considerable time before industry can completly shake off the effects of such weakening and nerve-wrecking maladies as have complicated the illness from which it has suffered, but there is within the patient the will to conquer any minor setbacks which may come along. Strength has now been gained which, it is hoped, will enable all further trials to be overcome. Industry has, it is confidently believed, become convalescent. Time and a continuance of favourable conditions should restore it to the full bloom of its past strength and greatness. On 'Change in Birmingham this week the market tone was reasonably firm. It is probable that more business was transacted than during the previous week, and there was much more inclination towards buying forward. It was reported that in one branch at least contracts were entered into which extend to the first quarter of next year. Inquiries in all departments were numerous, and a certain amount of trade has come to iron and steelmasters in this district, which a few weeks ago formed the subject of inquiry on 'Change in Birmingham. Although the consumptive requirements of Midland industries do not grow perceptibly yet there is undoubtedly a better call for many classes and grades of material. Native producers are recovering some small business from the foreigner, whose prices, except in one or two instances, do not compare favourably —everything taken into account—with those of Midland and Staffordshire makers. However, until inroads have been made into the heavy stocks of foreign iron and steel already in this country, the full benefit of the cessation of competition from the Continent will not be felt in this district, where at the present time and for a long past large quantities of foreign material have been worked up. Selling values of iron and steel manufactured in this district are in the main unchanged on the week. Supply continues in excess of demand. The outstanding reports from the works on the week show busier conditions amongst fencing manufacturers, improvement in the bright nut and bolt trade and unconfirmed rumours of brighter conditions in the general engineering works.

Pig Iron Contracts.

In the pig iron department of the Midland market there has been an extension during the week of the policy of contracting on forward account commented upon in my last letter. Some of the local foundries have now arranged for supplies over the first two or three months of next year. Moreover, inquiries have been in circulation concerning even longer contracts, but, as far as I can ascertain, February or March is the latest date to which definite business has so far been arranged. Though blast-furnacemen have much better order books than in the recent past, specifications against these orders come in rather slowly, particularly when they are on account of the general engineering foundries. Associated pipe foundries are using up the greater part of the Derbyshire production of foundry iron, while light castings manufacturers are taking the bulk of the output of iron from the Northamptonshire furnaces. Unfortunately, demand has not kept pace with production, and there remain heavy stocks at most of the furnaces. Ironmasters are looking for a reduction in these stocks before the end of the year, and they are hoping that increased consumption will account for it, and so avoid the necessity of further curtailing production. The scale of selling prices is again almost due for revision, but users do not anticipate any upward movement. At the time of writing, prices remain on the schedule fixed many months ago by the Central Pig Iron Producers' Association, under which Derbyshire No. 3 foundry iron costs £3 6s., forge £3 1s., Northamptonshire No. 3 foundry £3 2s. 6d., forge £2 17s. 6d., all per ton delivered to Black Country stations.

Steel Energy.

Slow progress continues to be made towards recovery in the steel trade. Rollers of strip and other special steels for the automobile industries are making increased outputs. Sales of steel scrap have been slightly heavier during the past week, while re-rollers of small bars are doing better business. So far there is no upward movement in the demand for constructional steel, but most other departments of the steel trade are showing more energy. The stoppage of free imports of Continental steel is a very important factor in the present improved steel outlook; indeed, in some quarters it is held to be the governing factor. True, local steelmakers have secured already some small benefits from the altered position. No one in this area is buying foreign steel just now, and it is felt that for some time, at any rate, the advantage is likely to remain with the home producer. It is realised, however, that the advantages which are expected to accrue must come gradually, in view of the existence of the very large stocks of foreign material in this country. The position encourages confidence, but it is felt that something should be done to stimulate consumption of structural and other finished steel materials. Steelmasters are holding to recent selling rates, alike in the finished and semi-finished departments, in spite of the fact that Continental quotations for small steel bars have hardened to £6 15s., and even £6 17s. 6d. Native steel values are as follows:—Angles, £8 7s. 6d., less 15s. rebate; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge, and tank plates, £8 17s. 6d., less 15s.; boiler plates, £8 7s. 6d. to £8 10s.; small bars, £6 15s. upwards for re-rolled, £7 upwards for all-British; soft billets, £4 17s. 6d. to £5 7s. 6d.; sheet bars, £4 15s. upwards; Staffordshire hoops, £9 10s. delivered.

Staffordshire Iron.

In the wrought iron trade of South Staffordshire there is not sufficient business to keep the mills employed regularly, although some of the marked bar makers have little to complain of in the matter of contracts in the last few months. The call for Crown iron and for common bars is very poor, notwithstanding that Belgian No. 3 bars, which compete for the nut and bolt and fencing-making trades have again advanced in price. Even to-day, however, Continental quotations are a guinea per ton below those of Staffordshire makers. Whereas local ironmasters quote £7 15s. to £8 for common bars, Belgian iron is available at £6 14s. There is slightly more work in the nut and bolt and hurdle industries in the Black Country at date, and ironmasters are hoping to get a larger share of business from these industries than they have had for some years past. It is thought that they might be prepared to meet users in the matter of price if bulk orders were at stake. A more hopeful view of the general situation in the industry is being taken. Sales of wrought iron tube strip are still advancing, and makers are, in increasing numbers, asking the full £10 10s. per ton for their output. It is still possible to get supplies at £10 7s. 6d., though this figure is now rarely quoted.

Galvanised Sheets.

There is no change on the week in the galvanised sheet market in this area. Demand is very similar to that experienced in October, overseas buyers keeping tonnages down to a rather low level. They move very cautiously in the matter of new contracts. Nevertheless, there is promise of much larger scope in the future for the sheet industry in several overseas markets. Prices are unchanged, the f.o.b. quotation for 24-gauge corrugateds being £10, and the delivered price for the home trade £11 5s. upwards, according to tonnage. Black sheets are £9 5s. in 10-ton lots, and they also have a rising scale for smaller lots.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Export Trade in Textile Machinery.

TEXTILE machinery exports last month were not only rather appreciably below the monthly average for this year, but they were also much lower, both in quantity and value, than in the corresponding month of 1931. The poor showings of recent months have naturally left their mark on aggregate shipments in this branch, and the year's exports will turn out to be very much less satisfactory than there was hope to expect on the figures for the early months of the year. In spite of this, however, the present year's shipments are almost certain to show a fair measure of improvement over those of 1931. During the month under review exports amounted to 4682 tons, valued at £409,607, compared with 5584 tons and £459,370 in October of last year, the past month's shipments including 3043 tons of spinning and twisting machinery, valued at £282,379, and 1191 tons of weaving machinery, of a value of £79,080. With the exceptions of China, South America, and Australia, all markets showed some degree of contraction compared with a year ago. Even to British India exports were appreciably lower, whilst those to Russia were valued only at £40 against £8728 a year ago and £54,216 in October, 1930. Notwithstanding the decline, however, shipments to India represented more than 30 per cent. of the total value of textile machinery exports during October, that country leading the way with £134,837. China was a poor second with £47,666, followed by South America, £31,272; Australia, £24,724; Japan, £19,358; Germany, £16,664; the Netherlands, £12,879; France, £11,246; and the United States, £7659. Shipments to "other European countries" reached an aggregate value of £61,437.

Mersey Tunnel Contracts.

At the last meeting of the Mersey Tunnel Joint Committee tenders were provisionally accepted for the building of three of the remaining five ventilating stations to be constructed in connection with the tunnel. Of the three, two were awarded to Henry Boot and Sons, Ltd., Sheffield, at a combined cost, inclusive of steel work, of £56,712; and the other to Robert McAlpine and Sons, Ltd., at a contract price of £76,928. Sir Thomas White, who was re-elected Chairman of the Committee, said that whilst they were now well aware of what the excess expenditure up to the present was, they could not yet say with any degree of certainty that they had reached the end.

Work for Birkenhead Shipyard.

The announcement that, in due course, the Admiralty will place the contract for the "Sea Lion," one of the two submarines in the 1931 programme, with Cammell, Laird and Co., Ltd., Birkenhead, is welcome news on Merseyside. The contract will help to provide continued work for the men already in employment, but it is doubtful if it will enable the builders to absorb many of those who are out of work. The firm is hopeful, however, of securing an adequate share of the work that will be included in the 1932 programme, tenders in connection with which are now in course of preparation.

Change of Name.

A proposal to change the name of the National Gas Engine Company, Ltd., Ashton-under-Lyne, to the National Gas and Oil Engine Company, Ltd., will be submitted at an extraordinary general meeting of the company early next month.

Non-ferrous Metals.

Easiness has been in evidence in all sections of the non-ferrous metals market during the past week, with copper relatively the worst sufferer in this respect, whilst spelter, on the other hand, has offered the biggest resistance to the setback. At the moment of writing, however, copper values are appreciably above the lowest that have been touched since last report, but this has been due more to extraneous influences, principally the fresh decline in the sterling rate of exchange, than to any improvement in the demand for the metal. Heavy stocks of both rough and refined are held in the country, and there is no indication of the general statistical position taking a turn for the better. Meanwhile, current quotations for standard brands of copper are in the region of 17s. 6d. per ton below last week's parities. The position of tin is less depressing than that of copper, but the past week has witnessed only moderate buying interest, and values are lower on balance by a little more than £3 per ton. The demand for lead has been less active than in previous weeks, and the recent advance in this section has been lost, a decline of 10s. per ton having brought prices back to where they were at the beginning of the month. Spelter has attracted a fair amount of attention and a relatively cheerful view of the prospects for this metal is being taken. Here also values have lost ground, but it has only been to the extent of between 2s. 6d. and 5s. per ton compared with a week ago.

Iron and Steel.

The iron and steel trades in Lancashire are slow to show much improvement so far as the leading heavy branches are concerned, although here and there sellers are disposed to take a more optimistic view. In foundry pig iron, the majority of makers report a somewhat better current demand in the aggregate, but except in odd cases there is not much disposition to buy forward to any important extent. Prices are maintained on the basis of 67s. per ton delivered to users in the Manchester area for Derbyshire and Staffordshire No. 3 iron, with Northants at 65s. 6d., Derbyshire forge at 62s., Scottish pig iron at from 83s. to 84s., and West Coast hematite at about 81s. per ton. The bar iron trade is on a quiet scale still, but prices are steady at £9 15s. per ton for Lancashire Crown quality bars and £10 5s. for best. After a week or two of better sales, the demand for alloy steels locally has quietened off again, but forge makers in several instances continue to report a better volume of inquiry from general engineers in the district and a slightly improved volume of actual business. The demand for steel from Lancashire constructional engineers, and also from boilermakers and locomotive builders is, however, slow, and orders are being handed out sparingly and for what is virtually prompt delivery. The fact that imported materials in many instances have now ceased to be competitive has not so far had much noticeable effect upon the demand for British materials, but this is expected to be experienced before long as stocks of the former are being steadily reduced. Re-rolled bars are firm at about £7 per ton, with sections quoted at £8 7s. 6d., joists at £8 15s., tank plates at £8 17s. 6d., acid and basic quality boiler plates at about £8 10s., and large-diameter bars at £9 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

Business in the hematite pig iron trade continues to be steady, and although there are no definite signs of a recovery, yet there seems to be a slightly better tone, generally speaking. Stocks are coming down at the works, and it is possible that Barrow will start producing iron in the course of a week or two, and when the furnaces get to work it will mean that the steel works will also become active. Business is mostly confined to home deliveries, and there is not much going either abroad or to America. The first real sign of an improvement in the pig iron market will be a stiffening in price, and when this happens buyers will come along with their orders. At present they are waiting in the hope of a further fall, which is far from likely. Iron ore is naturally quiet, with so few furnaces in blast not only in this district but elsewhere. The steel market remains dull, but certain orders are held and will be proceeded with when the ironworks are again at work. The hoop mills continue to experience a steady demand for their output.

Shipbuilding.

At last it is officially stated that Vickers-Armstrongs have received an order for a submarine from the British Government. It has been erroneously stated that this vessel is to be of the "Swordfish" class. The new submarine is to be named the "Severn," and will be of the "Thames" class, which means that she will be a bigger ship altogether. Further news of orders may come along in due course, but there is nothing definite at present.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Prospects.

A SUBSTANTIAL decline in foreign competition is likely to assist an improvement of the local steel industry. Crude steel of Sheffield manufacture is now obtainable as cheaply as the Continental article, and as soon as large stocks of foreign sheet, bars and billets rushed into this country before the duties were imposed, are exhausted, local manufacturers are likely to reap considerable benefit from the position created by the imposition of the duties. This is one reason for a feeling of optimism which exists in the local steel trade generally. It is not thought that

there will be any substantial revival before the New Year, but it is obvious that tendencies are in the right direction. For instance, a considerable amount of work is on hand in the lighter steel departments, and in the heavy section, although the general volume of output has not grown very much, one or two firms, such as the United Steel Companies, Ltd., are comparatively well placed.

Exports Improve.

Official returns for last month show that in the overseas markets certain sections of the steel industry have gained and others lost, but, on the whole, there is a tendency towards improvement. Obviously, the downward movement has ceased, and it is hoped that the advance will be maintained. Iron and steel materials exported during the month amounted to 160,430 tons, compared with 127,039 tons in September, and 158,812 tons in October last year. There have been increases in the exports of special alloy steels, steel sheets, galvanised sheets, hoops and strips, wrought tubes and railway steel, and decreases in cast pipes, plates, steel rods and sections. The improvement in railway steels is particularly gratifying, as this once important trade has been shrinking rapidly and consistently over the last three years, and has dropped to less than one-sixth of its former proportions.

Government Contracts.

A number of Sheffield firms will benefit from Government contracts which have just been placed. S. Osborn and Co., Ltd., J. Beardshaw and Son, Ltd., Burys and Co., Ltd., Thos. Firth and John Brown, Ltd., and Walter Spencer and Co., Ltd., are to supply high-speed steel and twist drills to the Admiralty, and Snow and Co., Ltd., have obtained a contract for machine grinding. Files and rasps are to be made for the War Office by Thos. Firth and John Brown, Ltd., and other work is to be done by Craven's Carriage and Wagon Company, Ltd. Sanderson Bros. and Newbould are another Sheffield firm to do work for the War Office.

Brown, Bayley's Steel Works.

Before the war more than half the turnover of Brown, Bayley's Steel Works, Ltd., Sheffield, was comprised of railway materials, but now these goods account for less than 20 per cent. of the turnover. This fact makes one appreciate the efforts which have been necessary in finding new branches of activity to make up for the lost railway work. Great progress has been made by the firm in the manufacture of special steels, stainless steels, &c., and many changes in plant and equipment have been necessary. New mills have been put down in recent years and steam plant has been replaced by electrically driven plant. In one mill, modernised recently, 14in. square ingots are rolled, each weighing about 23 cwt., and the output averages 116 tons per shift. A reversing mill motor has been put into service in another mill. The maximum speed of this mill is 70 r.p.m., and the motor is capable of carrying peak loads of 12,000 horse-power, the power consumed being about 32 units per ton of steel rolled in the mill. Lancashire boilers and a vertical boiler have been displaced.

Submarine Work.

Sheffield is likely to obtain considerable work as a result of the placing of Admiralty contracts for the building of the submarines H.M.S. "Severn" and H.M.S. "Sea Lion." The first-named is to be entrusted to Vickers-Armstrong, Ltd., Barrow-in-Furness, and the other to Cammell Laird and Co., Ltd., Birkenhead, and in both cases it is expected that the steel required and tools will be made in Sheffield.

Mersey Tunnel Contract.

The well-known Sheffield firm of contractors, Henry Boot and Sons, Ltd., has secured two contracts in connection with the construction of the tunnel under the Mersey, between Liverpool and Birkenhead. It is to build two ventilating stations for the tunnel, one at New Quay, Liverpool, and the other at Taylor-street, Birkenhead. The cost of the former will be £26,316, and of the latter £30,306.

Spring Steel Research.

Important research work on surface condtions of spring steel is being carried out at the Applied Science Department of the University of Sheffield, under the guidance of Professor J. H. Andrew. Although the work done has been confined to spring steels, the results will also apply to the steel trade generally. The object of the researches has been to ascertain the reasons for the loss of strength of laminated spring steel plates when finished in the form of a complete spring. It has been found that the surface condition of the plates has an important influence, and some valuable research work has been conducted on the origin and reason for these conditions. Very interesting problems have been revealed by the work. Assistance has been received by Professor Andrew from rolling mills and spring firms, many of whom have had some of the heat-treatment and rolling necessary for research carried out in their works.

Cutlery Firms Combine.

The oldest cutlery firm in Sheffield—Joseph Rodgers and Sons, Ltd.—is concerned in an agreement which has been made whereby certain assets of John Round and Son, Ltd., of Tudor Works, Sheffield, will be purchased. The agreement is subject to confirmation by the shareholders of the two companies, and to the approval of the Court for a scheme of arrangement affecting the capital of Messrs. Rodgers. Arrangements have been made whereby the products of John Round and Son will be manufactured at the works of Joseph Rodgers and Sons. The firm of Rodgers is one of the best-known cutlery firms in the world. It was established towards the end of the seventeenth century. Round and Son are also old established, a company having been registered in 1874 to take over the business established many years previously under the same name.

Railway Bridges.

The last of four bridges built for the L.M.S. Railway in the Buxton district since July was recently placed in position within four hours. This was the Buxton-Bakewell main road at the point where the Buxton to Sheffield and the Derby railway lines cross the river Wye. It takes the place of an old iron bridge which was inadequate and had to be cut away with acetylene burners. After its removal two temporary steel trestles were erected and along these the new bridge, weighing 700 tons and 150ft. long, was pushed into position. British steel was used in the construction of all four bridges.

Reservoir Scheme.

The Bakewell Rural Council has instructed engineers to proceed with the preparation of a scheme for the construction of a storage reservoir with a capacity of 3,000,000 gallons to supply the Stoke Flat area.

NORTH OF ENGLAND.

(From our own Correspondent.)

£30,000 Contract.

THE shipbuilding industry on the North-East Coast has received a little stimulus this week by the placing of an order with the Wearside Boat Building Company, of North Shore, Sunderland, for forty motor fishing boats for the North Cape Development Company, Ltd., of New Zealand. The contract is worth approximately £30,000. Each boat will be 30ft. long, and, equipped with Thornycroft oil engines, burning crude oil, will have a cruising radius of 900 miles. This welcome order—the first secured by a Wearside shipbuilding firm for some considerable time past—has been obtained against world-wide competition, and Mr. Harry Turley, the principal of the firm, attributes his company's success to the publicity secured through the firm's stand at the recent Olympia Exhibition. The New Zealand undertaking may be in the market for further craft shortly, and the hope is entertained that the Sunderland firm will again book the order.

New Teesside Industry.

A new industry, which is expected to provide employment eventually for a large number of workpeople, is to be established on Teesside. A company, to be known as the British Reinforced Thatch Company, in which a number of Teesside commercial men are interested, has entered into an arrangement with Dorman, Long and Co., Ltd., Middlesbrough, to lease from that firm one of the large brick hangars at the Marske Aerodrome, some 10 miles from Middlesbrough, for the purpose of manufacturing a building product described as reinforced thatch walling. Preparations are being made to install the machinery immediately, and, if satisfactory progress is made, work will be provided for about 150 people early next year.

Iron and Steel Trade Confidence.

It is a long time since those associated with the fortunes of the iron and steel industry of this district were in such a hopeful mood as they are at present. There is greater confidence all round, and one of the most encouraging features is the widening of the area from which inquiries are being received, and the greater disposition on the part of consumers to arrange forward contracts. A fair amount of business which in the past has been going to overseas producers has now been diverted to manufacturers in this area.

Cleveland Iron Trade.

Cleveland pig iron producers continue to be dependent mainly upon the flow of home trade, and the prompt demand is steadily increasing. In this section consumers see no advantage in committing themselves far ahead, and there is little forward contracting, but sales for early delivery are absorbing the output, and in some instances stocks are being drawn upon to meet commitments. Foreign iron is now shut out of the home market, but merchants find it difficult to negotiate sales of Cleveland iron to consumers abroad, even though they are permitted to take business at less than fixed prices for local deliveries. Home prices are firmly maintained, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Hematite prices are still below cost of production, but with raw materials tending upwards, makers of East Coast mixed numbers are taking up a firmer attitude. Recent additions to stock have only been small, and an improving demand promises to absorb the increased output. Mixed numbers are firm at 59s., with No. 1 quality at a premium of 6d. per ton.

Iron-making Materials.

There is an absence of any new feature in the foreign ore trade. Transactions are few, consumers having heavy stocks. Quotations, however, are firmer, owing to a rise in freights. Best Rubio is quoted at from 14s. 9d. to 15s. c.i.f. Tees. Blast-furnace coke is in ample supply. Good medium kinds remain at 14s. 6d. delivered to North-East works.

Manufactured Iron and Steel.

The brighter tone in the manufactured iron and steel trade is more pronounced. Several large contracts for finished steel are now in progress of negotiation, and manufacturers in this district are expecting a good proportion of the business. Buyers of several kinds of semi-finished steel have also appeared, and a number of sales have been arranged. Prices are firmly maintained. There is a considerable demand just now for scrap, and prices are strong. Consumers are keen to buy from stock, and substantial export sales have been made. As a further rise in values is confidently expected, sellers are now hesitating to enter into heavy commitments. Turnings are in demand at 28s., light cast iron is quite 34s., heavy cast iron 37s. 6d., and heavy machinery metal 40s., while 35s. is a buyers' figure for heavy steel.

The Coal Trade.

The free booking-up of steam coal over the remainder of this year has directed consumers' attention to deliveries for the first quarter of 1933, and for this period there is a fairly brisk inquiry. An encouraging feature is the increasing trade with Scandinavia. Some good contracts have been placed, and there may be more later on, as a result of discussions now proceeding between the representatives of those countries and our own. Before the war the United Kingdom had the Scandinavian coal business to itself, and the North-East Coast collieries took the greatest proportion, but during and after the 1926 stoppage of miners in this country, Poland stepped in and secured more than half of it, and it is only now that we are recapturing lost ground. Full recent prices are firmly quoted for Northumberland steam coals. For prompt shipment inquiry is good, but supply short, and few cargoes are on offer. Holders are asking a firm 14s. for best Northumberland qualities, and 15s. 6d. for prime Wear large. These brands of small are quoted steady, but supply is ample, Northumberland best at 8s. 6d. and Wear best at 11s. 1½d. Tyne prime large steam coals are moving freely, and output is fully taken up at 13s., and the supply of smalls is rather short at 9s. There is a good seasonal demand for gas coal, and although much below anticipation, it is still sufficient to give a strong tone, and sellers realise a steady range of value. Best Durham gas qualities are 14s. 6d. and second gas 13s. 3d. to 13s. 6d., with special sorts firm and rather scarce at 15s. Durham coking unscreened and smalls are steady, the demand showing some improvement in volume, 12s. 6d. to 13s. 3d. being still generally indicated. Best unscreened bunker coal is in active request, and firmly held, owing to the limited supply available, 14s. being difficult to discount. Second-grade bunkers are plentiful and just steady at 13s. The gas coke position maintains a firm tone, but business is limited by lack of supplies. The inquiry is active, but buyers have to go elsewhere for supplies. Prices are unchanged, gas coke at 18s. 6d. and vertical make at 23s. Patent oven coke is in ample supply and demand is on moderate lines. Prices of ordinary are unchanged at 15s., with superior at 16s. 6d. Coke nuts are steady at 16s. to 18s.

SCOTLAND.

(From our own Correspondent.)

The Position of Trade.

THE past week has been distinctly quiet so far as fresh contracts are concerned. On the other hand, evidence is not lacking that steps are being taken in preparation for a trade revival, which, in the opinion of perhaps the more optimistic, may be expected in the early spring. Probably, in view of the State injunction that manufacturers and others must do their part to establish an efficiency capable of dealing with a situation which, it is hoped, will arise from the efforts of the Government to stimulate trade, plants are being reviewed and advice sought in order to bring production methods up to date. New industries, or at least new to this district, have been and will be established. Graving dock improvements, Diesel engines for commercial motors, electric lamps, and artificial silk are among the new industries in certain districts.

Steel.

Inquiries for heavy steel have been more numerous, but firm business is difficult to secure, with shipbuilding still in a backward position. Structural engineering provides more specifications than most of the other branches. Exporters, however, take a more hopeful view, possibly because of the improvement in sheets. Although the overseas response to the higher price of sheets has not been particularly free, heavier gauges have been more prominent than for some time past. Inquiries from South Africa and the Far East are more numerous. The demand for galvanised sheets is moderate.

Iron.

The demand for bar iron is still most irregular. Re-rolled steel bars are a shade better off, though not by any means heavily committed. They are quoted £7 5s. home and £6 10s. per ton export delivery.

Pig Iron.

Dealings in pig iron are confined to small lots of foundry and hematite, and as a rule from stock. Last week 800 tons of pig iron arrived here from Barrow.

Scrap.

Scrap metal is unchanged in price at £1 15s. heavy steel and £2 7s. 6d. per ton for cast iron machinery.

Distribution of Oil Fuels.

The Anglo-American Oil Company, Ltd., has in hand a further development of its depôt at Bowling. It is hoped shortly to ship motor and marine fuels direct from America for distribution throughout the country. The development is estimated to cost about £50,000.

Coal.

The strength of the market and the continued upward movement of prices reflect the scarcity of export fuel. Quota restrictions have cut down supplies at a time when both export and home demands show a seasonal

improvement, with the result that some fuels are now practically unobtainable for delivery this year. In order to meet this shortage the Central Council has been approached with a view of increasing the quota. It is understood that the increase asked for amounts to 400,000 tons. Meanwhile all large and small fuels are scarce, with the exception of Lothian double nuts, and prices continue upwards. Aggregate shipments amounted to 251,768 tons, compared with 265,639 in the preceding week and 247,819 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

SHIPMENTS of coal and coke from the six ports under the control of the G.W.R. Company in this Channel were better last week than the preceding week, the figures being 396,275 tons, as against 380,050 tons, though the quantity for the corresponding period of last year was 451,953 tons. The tonnage position varied from day to day and the week finished up with thirty-eight idle tipping appliances at the ports between Newport and Port Talbot, though this week commenced with a slight improvement on that figure, as the total on Monday was twenty-four. Swansea, where anthracite coals are mainly shipped, regained its strong position from the point of view of loading pressure. At one time recently the diversion of tonnage to Port Talbot actually resulted in tips being idle at Swansea, but by the end of last week the number of waiting steamers rose to six, while on Monday last as the result of week-end arrivals, the situation was that no less than seventeen vessels were waiting to get a berth. Shipments of anthracite coal for Canada have now come to an end, but, because of the demand for anthracite in other directions, the loading activity at Swansea is fully sustained. It cannot be said that the demand for steam coals displays any perceptible expansion. The Spanish Naval Commission contracted last week for 8000 tons of Admiralty large coals for delivery at Ferrol, Carthagena and Cadiz promptly, but the labour troubles in Spain have not so far brought along fresh orders About 28,000 miners at the Asturian mines came out on strike last week as a protest against the action of the Spanish Government, which, it was alleged, had not kept its promise to safeguard the workers in the coal industry against the effects of British competition. Although no news has been received that the strike has come to an end, the advices from Spain are that it is not expected to be of long duration, neither is it likely to have the effect of inducing much, if any, fresh inquiry for British coals.

Coal Questions.

A number of interesting matters have been before all concerned in the coal industry during the past week or so, not the least important being that relative to the proposal to impose a levy on coals for inland purposes in order to subsidise the export side of the industry. From accounts to hand the subject was before the Central Committee of Coalowners at a meeting in London last week, but, in conjunction with other questions, was deferred. This has been construed as being the end of the matter, as there was a good deal of opposition to the scheme, some coalowners who formerly favoured the proposal having altered their views. The opinion held in some quarters was that the proposal was certainly having the effect of inducing foreign buyers to hold off, in the expectation that by so doing they might be able to purchase their requirements at a lower figure, comparable with the amount of the subsidy. One subject upon which it is stated that the Coalowners' Central Committee achieved a certain measure of agreement was on the desirability of co-ordinating the schedule of minimum prices between the various districts. It is understood that the Committee had before it an application from the Scottish coalowners for a further increase in their quota of 400,000 tons to enable them to meet the exceptional demand which prevails. So far this year exports from Scotland show an increase of 1,250,000 tons, but, in the case of other districts, it has been very different. Naturally, the conclusion to be drawn is that Scottish prices have been relatively too low, compared with the schedules for other areas, and in the circumstances the application of the Scottish coalowners was declined, and they were advised to raise their prices. The complaint of South Wales for some time past has been that business which formerly came to this district has been transferred to the North on account of the disparity in prices prevailing.

Swansea's Shipment Facilities.

On more than one occasion reference has been made to the necessity of steps being taken to improve the coal shipment facilities at Swansea, if the increased export trade in anthracite which is looked for is to be coped with. Detention in port is the bugbear of shipowners, and many of them have experienced a good deal of this trouble in the past few weeks. It is all the more satisfactory, therefore, to find that the Great Western Railway Company is alive to the position, and, what is more to the point, is ready to do its utmost to assist traders, as will be seen from the fact that the company has authorised a scheme which will mean an outlay of over £100,000 to improve the rail access to the Swansea docks. It is not that extra provision is being made in the way of siding accommodation, but the scheme is what is described as a traffic-operating scheme to facilitate the movement of traffic through the sidings. At the same time, it may be added that the company is erecting a new hoist at the King's Dock at a cost of £50,000.

Iron and Steel Industry.

Reference was made last week to the improved tone prevailing in the iron and steel industry, but this week there is more evidence of this fact. It is reported that the demand for pig iron is expanding appreciably, and stocks are undergoing reduction with better prices prevailing. It is also noticeable that imports of foreign bars and billets are on a much lower scale. Although the heavy side of the industry has not so far felt the improvement to any extent, there is a confident feeling that the end of this year and the early part of next year will witness a change for the better. Three furnaces at Baldwin's Steel Works, Landore, Swansea, were due to be in operation this week, the third of these having been prepared for lighting last Saturday. The mill department was also due to restart about the middle of this week, and it is expected that in the course of the next few weeks the two remaining furnaces will be lighted. Hopes are entertained that the big furnace now undergoing construction at the Dowlais Works, Cardiff, will be got going in the early part of the New Year. The remarks of Mr. Lewis Jones, M.P., secretary to the South Wales Siemens Steel Association, at a dinner at Swansea on Saturday, are of interest, as bearing on the situation. He said that he would like those present to know that there were definite signs that Swansea, as one of the most important steel-producing districts in the country, was well on the path to recovery. There was an air of confidence about that was justified by actual facts.

Cardiff's Omnibus Experiment.

At the end of last week the manager of the Omnibus and Tramways Department presented to the Cardiff Tramways Committee an interesting report in which he explained that, for experimental purposes, one of the Corporation omnibuses had been fitted with a heavy-oil engine. It had now run 36,000 miles and had acted extremely well. Petrol cost the Department 1s. 2d. per gallon, and gave an average of 6 miles to the gallon with an omnibus of the same type as the heavy-oil engine omnibus. Fuel oil for the latter cost only 4d. per gallon, and gave an average of 9½ miles to the gallon. In other words, it cost 2·4d. per mile to run a petrol-driven omnibus, and 0·42d. to run a heavy-oil omnibus, so that there was a saving of 2d. on every mile run on heavy oil. The Cardiff omnibuses ran over 4,000,000 miles per annum, so that if all the omnibuses were driven on heavy-oil they would be able to save £30,000. In these circumstances, the Committee was justified in making further experiments with heavy-oil engines. It so happened that another company had now come along with an offer of an omnibus on hire terms which meant that the demonstration omnibus could be run at 1d. per mile. That figure would be still further reduced, because the company would be responsible for all replacements during the period of the experiment. The Committee unanimously authorised the company's offer to be accepted. The experiment is all the more interesting as the heavy oil used can be produced from South Wales coal, and, as the manager remarked, it is for the coal trade to adapt itself to the changing conditions.

Engineers' Exhibition.

The annual engineering exhibition organised by the South Wales Institute of Engineers, was due to be opened at Cardiff on Wednesday and will remain open to December 3rd. For variety and interest it excels all its predecessors. All the ground space available for stands at the Greyfriars Hall was taken up some time ago. The opening ceremony was performed by Mr. D. Farr Davies, F.G.S., the President of the Institute, while the Lord Mayor of Cardiff extended an official welcome to the exhibitors.

Miners' Federation Reorganisation Scheme.

Delegates to the special conference of the South Wales Miners' Federation at Cardiff on Monday declined by a small majority to accept the scheme prepared by the executive for the reorganisation of the Federation. The result was that it was decided to appoint a Joint Committee of representatives of the Executive Council and of the Conference for the purpose of drafting another scheme to be submitted to another conference.

Miners and Wages.

The delegate conference of the South Wales Miners' Federation at Cardiff on Tuesday devoted considerable time and discussion to the question of wages, two methods of improving the men's conditions being put forward. One was the furtherance of any movement calculated to secure the increased consumption of coal instead of oil, and the other was that a new Minimum Wage Act should be pressed for. Ultimately a resolution was adopted pressing the M.F.G.B. to endeavour to secure the passing of an amending Wage Act which would secure for the workmen a wage commensurate with the cost of living, and further that profits from by-products should be taken into consideration as profits of the coal mining industry.

Anthracite Pit to Close.

About 500 colliers and surface men at the Pantyffynnon Colliery, Amman Valley, have received notices to terminate their employment on December 3rd, and the colliery is to close down temporarily on account of unremunerative production. The colliery belongs to the Amalgamated Anthracite Collieries, Ltd.

Current Business.

The tone of the steam coal market continues without notable change. Large coals of most descriptions are freely available, dry large, perhaps, being an exception. Sized coals and washed smalls are scarce and firm. Patent fuel remains rather quiet, while coke moves off moderately well. Pitwood is slow in demand, but prices are maintained.

SELF-UNLOADING STEAMERS.

IN the growth of American shipping on the Great Lakes there has been a marked development of self-unloading vessels for the transportation of such bulk cargoes as stone, sand, gravel, cement, and coal. Such vessels are independent of shore equipment, and can unload their cargoes readily at points where shore unloading machinery is inadequate or non-existent. This is a special advantage in connection with marine construction works, since materials can be delivered at any point where needed. Thus in the construction of a large breakwater the steamer "Fred Green" delivered sand and gravel for concrete in stock piles on shore by means of a belt conveyor on a pivoted boom; crushed stone for the base of the concrete blocks was placed in deep water in the same way or deposited in stock piles, a revolving wheel or spreader at the end of the boom throwing the material to a considerable distance beyond the end of the boom. Two revolving cranes, over the forward and after holds, handled large stones for filling the hollow concrete blocks. Cement is handled usually in pipes by compressed air, being delivered to closed storage bins at a considerable distance. For sand and stone the hold has a hopper bottom with gates over two parallel tunnels in which run belt conveyors. At the bow these conveyors discharge into the boot of a steep inclined endless chain conveyor which slopes aft and extends above the deck, discharging into a hopper or bin. From this bin the material flows by gravity on to a belt conveyor carried by a steel truss boom which is pivoted at the loading end and can be swung outboard at right angles to the vessel. The "Bradley" is 615ft. long, 65ft. beam, with boom 160ft. long, and has a hold capacity of 14,000 tons. It has turbo-electric propelling machinery and all the conveyors and other mechanical features are operated by electric motors.

EDUCATIONAL INTELLIGENCE.

SPECIAL LECTURES ON PRODUCTIVE INDUSTRIES.—It is now announced by the Imperial College of Science and Technology that Mr. Maurice Solomon will deliver a lecture on "The Electrical Industry with Special Reference to the Advantages of the Large Industrial Organisation," on Thursday, December 1st, 1932, at 4 p.m., at the Royal College of Science, Exhibition-road. See page 495 for further particulars.

Two Studentships, each of the value of £250 and tenable for two years, have recently been founded by the trustees under the will of the late Lord Leverhulme. These Studentships are to enable graduates in chemistry or engineering to obtain advanced training in the principles and practice of chemical engineering in the Ramsay Memorial Laboratory of Chemical Engineering at University College, London. The Studentships have been awarded to Mr. P. C. Carman, M.Sc., and Mr. H. Lewis, B.Sc.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. R. P. HILTON, A.M.I.E.E., has recently joined the staff of Bruce Peebles and Co., Ltd., Edinburgh, as chief sales engineer.

THE following new members have been elected to serve on the Council of the British Engineers' Association for the ensuing year:—Colonel J. S. Ruston, chairman, Ruston and Hornsby, Ltd., Lincoln; R. E. Trevithick, assistant general manager, Dewrance and Co., 165, Great Dover-street, London, S.E.1.

COUNCILLOR REGINALD BROWN, M.B.E., M. Inst. C.E., Chairman of the Highways Committee of the Westminster City Council, has been elected first Chairman of the new Standing Committee on London Cleansing. The duty of the Committee is to consider and advise upon the collection and disposal of London's refuse and the cleansing of its streets.

CONTRACTS.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., Loughborough, has received an order for a 3750-kW "Brush-Ljungström" turbo set for the Government of Malta.

YARROW AND CO., Ltd., Scotstoun, Glasgow, inform us that in collaboration with their associates in South Africa, Messrs. Guest Sykes, Johannesburg, they have received an order for three water-tube boilers for the power station at the new steel works of the South African Iron and Steel Industrial Corporation, Ltd., at Pretoria.

W. A. CHRISTIANSEN, of 7 and 8, Poultry, London, E.C.2, informs us that an order for a hydrographic survey ship, 210ft. long by 35ft. beam by 19ft. depth by 11ft. mean draught, has recently been put in hand at the Ferrol yard of the Sociedad Espanola de Construccion Naval, to the order of the Spanish Government. The propelling machinery of 850 I.H.P. will be designed to give a normal speed of 12 knots. The main engine will be of the Christiansen four-cylinder double-compound type, and is being built at the Ferrol works, under licence from Christiansen and Meyer, of Harburg-Wilhelmsburg, Germany. Steam will be supplied by two oil-fired water-tube boilers of 215 lb. working pressure and 150 deg. Fah. superheat. The Ateliers et Chantiers de France, of Dunkirk, are building under licence two Christiansen four-cylinder double-compound engines of 480 I.H.P. normal for a dredger. The engines will be arranged to drive either the propellers aft or the dredging machinery forward.

CATALOGUES.

HYDRAULIC ENGINEERING COMPANY, Ltd., Chester.—Catalogue T.B. 34, giving details of the Mangnall-Irving thrust borer.

NEWTON, CHAMBERS AND CO., Ltd., Thorncliffe, near Sheffield.—A leaflet on Thorncliffe-Baldurie concentration plant for gas liquor.

GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, W.C.2.—"M" section of catalogue dealing with measuring instruments.

BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, E.C.4.—A brochure on "Aluminium Busbars and Connections."

A SMITHFIELD SHOW DINNER.—His Highness the Maharaja Jamsaheb of Nawanagar ("Ranji") is to be the guest of honour of R. A. Lister and Co., Ltd., the agricultural engineers, of Dursley (Glos.), at their annual Smithfield Show dinner, which takes place this year in the Café Royal on Wednesday, December 7th. It will be attended by 500 Lister agents and distributors from all over the country. Mr. Percy Lister, managing director of the firm, is to preside. After the dinner the entire party, "Ranji" included, is going on to the Saville Theatre, where all the stalls have been reserved.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 24/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 7 6	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. Coast—		
Hematite Mixed Nos.	2 19 0	2 19 0
No. 1	2 19 6	2 19 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold-blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (a) / 4 0 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
Lancs.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 7 6 to 10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 5 0—10 Ton Lots and Upwards Delivered Glasgow Stations.	10 0 0
„ (Gal. Cor. 24 B.G.)	For Canada	10 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 15 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets	11 5 0 to 12 15 0	10 0 0
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/-
Block Tin (cash)	153 7 6
„ (three months)	154 10 0
Copper (cash)	32 0 0
„ (three months)	32 5 0
Spanish Lead (cash)	11 18 9
„ „ (three months)	12 6 3
Spelter (cash)	15 7 6
„ (three months)	15 10 0
Manchester—	
Copper, Best Selected Ingots	37 0 0
„ Electrolytic	38 0 0
„ Strong Sheets	65 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11½
Lead, English	14 0 0
„ Foreign	12 7 6
Spelter	15 10 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/7½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 15 0	8/-
„ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ 8 p.c. to 10 p.c.	£22 5 0	7/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£36 10 0	11/-
„ „ 1 p.c. carbon	£42 12 0	14/-
„ „ 0·70 p.c. carbon	£44 0 0	16/-
„ „ carbon free	1/- per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	15/6
„ „ Splint	15/6 to 16/6
„ „ Trebles	15/- to 16/-
„ „ Doubles	13/- to 13/6
„ „ Singles	11/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/- to 13/6
„ „ Jewel	16/6
„ „ Trebles	15/6 to 16/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/-
Screened Navigation	16/6 to 17/6
Trebles	17/- to 18/6
Doubles	13/6 to 14/6
Singles	11/6 to 12/-
Lothians—	
(f.o.b. Leith)—Best Steam	13/- to 13/6
Secondary Steam	12/6
Trebles	15/6 to 16/-
Doubles	12/6 to 13/-
Singles	11/- to 11/3

(8) N.W. Coast— ENGLAND.

Steams	20/- to 21/6
Household	32/6 to 52/6
Coke	19/- to 22/6
Northumberland—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

Sheffield—	Inland.
Best Hand-picked Branch	27/- to 28/- —
South Yorkshire Best	23/- to 24/- —
South Yorkshire Seconds	18/- to 21/- —
Derbyshire Best House	22/- to 23/6 —
Derbyshire Best Brights	18/- to 20/- —
Screened Seconds	17/6 to 19/- —
Kitchen Coal	16/6 to 17/6 —
Best Screened Nuts	17/- to 18/6 —
Small Screened Nuts	16/- to 16/6 —
Yorkshire Hards	17/- to 18/- —
Derbyshire Hards	17/- to 18/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	7/- to 8/6 —
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	14/6 to 15/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 31/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	20/-
Pitwood (ex ship)	22/- to 22/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/6
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Marine Exhibition.

THE annual Marine Exhibition was initiated seven years ago with the object of creating a national interest in navigation on the 9000 miles of inland waterways in this country and of developing boat building and engine construction. It is still mainly of a popular character, with exhibits of river craft and small engines, and the efforts made to extend its usefulness in the direction of the heavier branches of marine engineering have been fairly successful, though it cannot be said that the show this year indicates any notable industrial progress. It is held under canvas on the Cours la Reine in Paris, with the Seine embankment down below where engines are shown in motion and boats and yachts on the river are moored alongside. The absence of some of the usual foreign exhibitors can only be attributed to the economic crisis. The Navy Department and the merchant marine are both represented with models, the latter also showing diagrams indicating the development of the merchant marine, the tonnage of which has nearly doubled since 1914, and of pleasure craft, which have grown at an equally rapid rate contemporary with the holding of the exhibitions. The small boats have provided fair business in outboard engine and propeller units, and the increasing number of makers of units, and the larger sizes of some of them, imply the growing popularity of this type of detachable power equipment. In the bigger sizes the propeller is usually made a unit with the engine installed in the stern, and the vertical propeller shaft casing is hinged at its upper extremity so that by the removal of a bolt it can be raised in case of emergency. On some of the barges in Belgium there is a similar arrangement with much more powerful engines, and the experience acquired with detachable power and propelling units over a wide range has given it a definite place in public favour. There are additions to the number of French firms which manufacture solid injection marine engines, and while they are somewhat late in the field they are making up lost ground, though many of them prefer to work under foreign licences than to attempt to design engines themselves. For the first time there is an impression that French builders of solid injection engines have got into their stride. Renault, the Chantiers de la Loire, the Compagnie Lilloise de Moteurs, S.M.I.M., Baudoin, of Marseilles, and others are showing heavy-oil engines with mechanical injection. While German, Belgian, and Swedish engine builders appear to have given less support to the Exhibition this year, no doubt for economical reasons, Great Britain is represented by the firm of John I. Thornycroft and Co., Ltd., which shows some models of big cruising yachts, and by R. A. Lister and Co., Ltd.

The European Public Works Syndicate.

On September 9th last a French limited company was registered under the style of Syndicat Européen d'Entreprises. Its capital is 1,000,000f., in shares of 10,000f., which may be raised to 2,000,000f. by the board of directors. According to the statutes the company's object is to study and negotiate schemes of public works in all parts of the world (except the British Isles, France, and Germany), and to make all the necessary financial arrangements with banks, &c. The shares have been subscribed mainly by four French, three British, and two German companies. The British shareholders are :—Dorman, Long and Co., Holland and Hannen and Cubitts, Limmer and Trinidad Lake Asphalt, and Mr. J. B. Stevenson, managing director of Holland and Hannen and Cubitts. The French participants are :—Société Générale d'Entreprises, Société d'Entreprise Fougerolle, Les Grands Travaux de Marseilles, Compagnie Fives Lille, and Monsieur Louis Marlio, the vice-president of the Union des Industries Metallurgiques et Minières, and a member of the boards of over a dozen prominent electricity supply and mining concerns. Germany is represented by Julius Berger A.G. and Philipp Holzmann A.G. It is understood that Great Britain and France will participate in the work of the Syndicate to the extent of 40 per cent. each and Germany to the extent of 20 per cent. These percentages apply both to the capital to be furnished to finance the works undertaken and to the respective shares in the supply of the machinery, plant, and materials required.

Electrical Production.

The production of electricity by thermal and hydraulic plants so far exceeds requirements at the present moment that there is some doubt as to whether the new power stations now being constructed or projected will be able to pay their way. The total consumption of current in France increased from 13,390 million kWh in 1929 to 16,200 million kWh in 1930, but in the following year it dropped to 13,000 million kWh, and since then there is every indication of a continued decline. On the other hand, the consumption for domestic purposes and for public lighting is steadily increasing, and it is hoped that the industrial consumption will recover and catch up the production when the crisis comes to an end. Nevertheless, the expectation that industries would be attracted to the centres of hydro-electric supply has not been entirely realised, though electro-metallurgical and electro-chemical industries have been established there. It is evident that the great bulk of the energy produced will have to be distributed over increasingly wide areas, in which event the cost of current to the consumer can never fall below a figure determined by the high amortisation charges and cost of maintenance. There is no longer any question of current being supplied at such cheap rates all over the country that everyone will be obliged to use it, even in remote rural districts, but every effort is being made to encourage and facilitate consumption with a view to reducing imports of coal. At the moment there is an over-production of electricity which leads to the belief that it may not be prudent to push forward too rapidly the schemes for further hydro-electric supplies, at least until such time as there are signs of improvement and a possible extension of consumption. Several hydro-electric power stations are in course of construction in the Massif Central and elsewhere, and will add considerably to the quantity of energy available during the next two or three years. When the national electrification scheme is completed it may become necessary to export energy.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

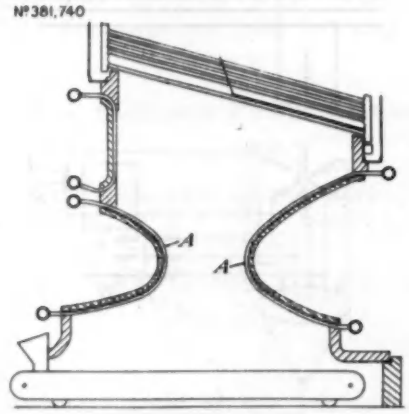
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

381,740. October 30th, 1931.—COMBUSTION CHAMBERS OF WATER-TUBE BOILERS, *Babcock and Wilcox, Ltd., Farringdon-street, London, E.C.4.*

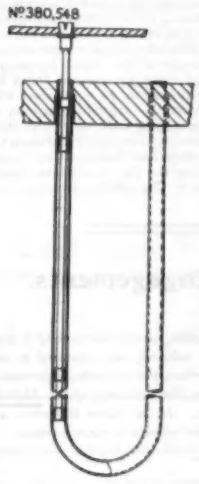
The water-cooled walls of the boiler furnace are formed

Nº 381,740



of tubes A, A, to which there are welded radial fins on the concave side of the curvature. The result is that trapezoidal cavities are formed which ensure the retention of the refractory material applied in a plastic state.—*October 13th*, 1932.

Nº 380,548



380,548. July 20th, 1931.—HIGH-PRESSURE WATER-TUBE BOILERS, W. Yorath Lewis, 17, Woronzow-road, St. John's Wood, London, N.W.8.

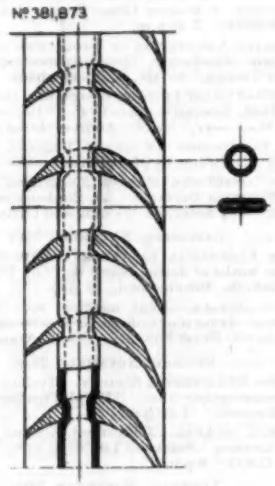
In order to reduce the number of drums subject to high pressure in water-tube boilers, and thus economise in the expense of construction, the inventor uses a modified form of Field tube. The tube, as is shown, is bent into the form of a U and into one, or both, legs an inner circulating tube is introduced. The circulating tubes extend through the water space through a secondary tube plate or baffle. The specification illustrates several forms of boiler with this type of heating surface.—*September 22nd*, 1932.

TURBINE MACHINERY.

381,873. April 22nd, 1932.—STIFFENING TURBINE BLADING, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2, and F. Samuelson, 44, Hilmorton-road, Rugby.

The low-pressure blading of steam turbines is laced together to prevent the blades vibrating, by threading through holes

Nº 381,873



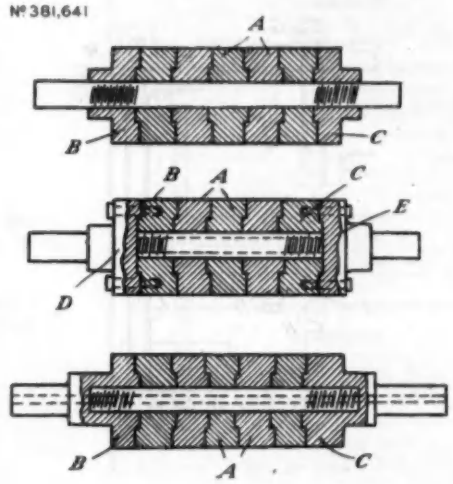
in the blades a tube, which is subsequently flattened in the spaces between the blades to key the whole assembly together. The merit of using a tube, instead of a wire, is that it can be made of a comparatively hard metal and yet be sufficiently deformable.—*October 13th*, 1932.

DYNAMOS AND MOTORS.

381,641. July 31st, 1931.—ROTORS FOR DYNAMO-ELECTRIC MACHINES, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

The invention relates to a rotor body for synchronous dynamo-electric machines in which the discs forming the middle portion of the rotor body are held together under pressure by end discs mounted on the supporting shaft and are pressed together by shrinking the shaft in the axial direction. Several constructional examples of the invention are shown. The discs A are pressed together by the end discs B C, which are screwed or shrunk on to the shaft, the shaft then being shrunk to press together the intermediate pieces. The individual forgings are provided on opposite surfaces alternately with projections and recesses, which fit snugly one in another and serve the purpose of reinforcing the discs with respect to one another and of relieving

Nº 381,641

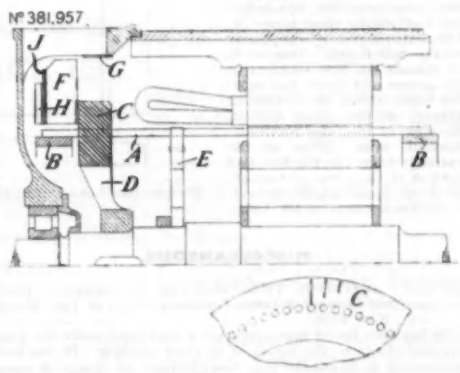


the shaft of bending stresses, so that the supporting shaft may in some cases be made hollow. The shaft which supports the discs may act directly as the rotor shaft or separate flanges D E, with stub shafts integral with them, may be fixed to the end discs in any suitable manner, as, for instance, by means of screws, as shown in the centre drawing. The pressure-applying flanges B C which are pushed on to the threaded ends of the supporting shaft may also be themselves provided with the journals as shown in the bottom drawing. Instead of the end discs which assist in pressing the discs together being screwed with a thread on to the supporting shaft, these pressure-applying discs may be shrunk under pressure directly upon the supporting shaft. For shrinking the shaft in the axial direction the supporting shaft may be made hollow and be heated up from within while the end discs are being screwed or shrunk on.—*October 13th*, 1932.

381,957. July 11th, 1931.—ELECTRIC MOTORS, Lancashire Dynamo and Crypto, Ltd., of Trafford Park, Manchester, and John Whiteley Howard, of 21, Sandy-lane, Stretford, near Manchester.

The object of this invention is to improve the starting characteristics of induction motors, and obtain comparatively high starting torques without loss of efficiency at normal speed, by a cheap and strong mechanical construction of squirrel-cage rotor. The rotor bars A are carried through the slots of the rotor cores, and connected to resistance end rings B. A ring C is connected by an armed part D to a boss keyed to the shaft. The axial and radial dimensions of the ring C are such as to provide a cross section in the vicinity of the holes through which the bars pass of ample area to permit the generation of a magnetic flux sufficient to generate eddy currents of the magnitude required to reduce the current in the bars to the desired

Nº 381,957



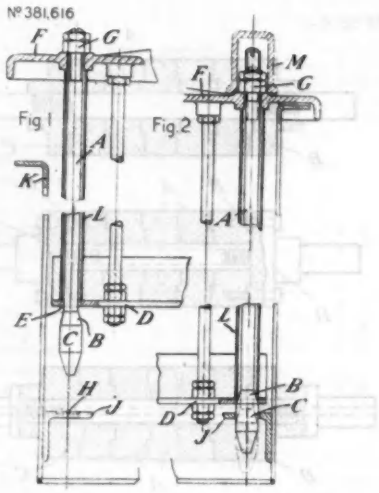
value, when the rotor periodicity is a maximum. There are as many holes in the ring as there are rotor bars, and where the latter are skewed in the rotor core the holes may be skewed. The magnitude of the magnetic flux in the ring may be adjusted by forming transverse slots extending from the holes, or from some of them, to the periphery. The auxiliary supports E may be arranged so that each is metallically connected to equipotential groups of the rotor bars. The ring C is usually arranged to carry the rotor fan, the blades F of which are carried by a disc secured by brazing or bolting to the ring C. A baffle plate G is fitted, and preferably a smaller auxiliary fan H is formed by blades attached to the plate J on the blades F of the main fan, the arrangement being such as to ensure the necessary air flow round the stator windings, between the core plates and through the rotor spider.—*October 11th*, 1932.

TRANSFORMERS AND CONVERTERS.

381,616. July 13th, 1931.—FIXING DEVICES FOR ELECTRICAL APPARATUS, SUCH AS ELECTRIC TRANSFORMERS ENCLOSED IN A CONTAINER, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2, and William Stanley Adams, of "Bella-Vista," 12, Vernon-avenue, Hillmorton Paddox, Rugby.

This invention relates to means for securing electrical apparatus, such as an electric transformer. In connection with

such apparatus difficulty is sometimes experienced in securing it so that during transport neither the container nor the article is damaged, owing to movement of the apparatus inside the container. The object of the invention is to overcome this difficulty, and to that end it consists in dowel or pin members suspended from the cover of the container and adapted to register with an aperture formed in a projection from the side of the interior of the container. The dowel consists of a long shank A screw-threaded at its upper end. At its lower end this shank is provided with a short tapered portion B and an enlarged cylindrical portion C. The transformer, or other electrical apparatus to be suspended in the tank, is provided with a projecting member D, which may be part of the suspension frame. It is provided with tapered apertures E through which the shank A of the dowel passes. When being assembled, the screwed portion of the shank is passed through apertures in the cover F of the tank, and a nut G is screwed on its outer



end until the tapered portion B is firmly seated in the apertures E in the member D, when the nuts may be locked in any convenient manner. When the transformer is lowered into the tank the lower end of the dowel enters an aperture H formed in a flange J secured to or formed integral with the wall of the tank K. To facilitate entry of the dowel pin into the aperture H the lower end of the pin may be tapered, and the aperture H may be countersunk on its upper side. When the tank is fixed in its operative position, the nut G may be slackened off so that the dowel will drop to the position shown in dotted lines in Fig. 2, and the transformer may have a limited movement relatively to the tank. In some cases the shank A may be mounted in a tube L which serves to protect the shank when the transformer is being lowered into the tank. Where the transformer is to be used for outdoor service a cover M may be provided for the lock nuts as shown in Fig. 2.—*October 13th*, 1932.

BUILDING.

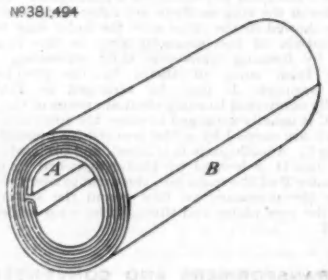
381,480. March 21st, 1932.—Metal Beams, D. H. Lee, The Aston Construction Company, Ltd., 46, Eagle Wharf-road, London, N.1.

This invention relates to improvements in the shape and cross section of metal beams. By this invention beams of I section are so formed that the bottom flange is thicker and narrower than the top flange, which is thinner and wider. In addition, these beams are so formed that the flanges are approximately equal in area, but there may be more cross sectional area below the half depth than above it. The centre of gravity is kept near to the half depth. This tends to balance the first moment of the upper and lower halves of the beam about the centre of gravity of the cross section. Because of this the maximum flexural fibre stress at the extreme fibres at the top and bottom of the cross section are of about equal magnitude and an efficient distribution of metal is obtained.—*October 6th*, 1932.

MISCELLANEOUS.

381,494. April 11th, 1932.—Electric Condensers, International General Electric Company, Inc., of 120, Broadway, New York.

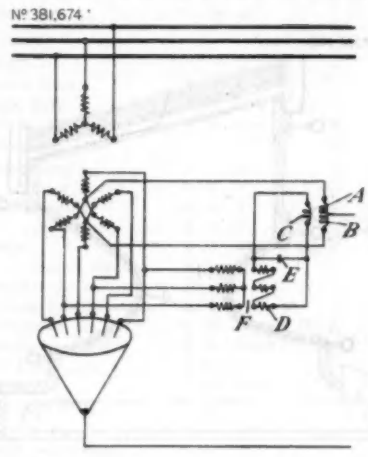
It has been found that in service wound condensers lose their original shape or the tightness of their winding. It has been attempted to eliminate this disadvantage by means of cores, which remain in the wound element when the condenser is in



service, but as the coefficient of expansion of the material of the core is usually different from that of the coiled material, the results are not always satisfactory. In accordance with the invention, a resilient core is placed in the wound element to keep it under tension when in service. The drawing shows a constructional example in which the core A is a longitudinally slit metal tube. The material B forming the condenser is wound under tension on this slotted core, which is slipped over a former of somewhat smaller diameter, so that the core is compressed to a certain extent in the course of the winding operation, and therefore cannot turn. The resiliency of this core causes the coil to remain tight and to retain its original capacity value under temperature variations or small deformations.—*October 6th*, 1932.

381,674. August 28th, 1931.—Polyphase Rectifier Installations, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

Arrangements are already known for eliminating the rise in the voltage curve at low loads of a mercury vapour rectifier operated with an interphase transformer between the neutral points of the secondary windings of the transformer. The invention relates to an arrangement in which the auxiliary transformer is small, and the voltage at the interphase transformer may be made greater than in the case of interphase transformers with self-excitation. A is an interphase transformer, the winding B of which is connected as shown, while the exciter winding C is fed from the secondary winding D of the exciter transformer F. E is a condenser, which supplies the magnetising current of the third harmonic for the interphase transformer. The transformer F is highly saturated,



so that the magnetising current has a pronounced third harmonic. This current flows, however, in the open delta secondary winding D and through the exciter winding C. Since the exciter transformer for the excitation of the interphase transformer must be very strongly saturated, it needs from the network a substantial reactive current to produce a strong third voltage-harmonic. To this reactive current is added the third harmonic current of the interphase transformer, so that the exciter transformer has to supply the sum of both currents of the third harmonic, and it therefore takes a substantial reactive current from the network. The advantage of the application as compared with the known arrangement is that the exciter transformer may be reduced in size, because the magnetising current of the third harmonic for the interphase transformer is supplied through the condenser, and the exciter transformer has therefore no longer to supply the third harmonic current for the interphase transformer, but only its voltage.—*October 13th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

To-day.

Chartered Inst. of Patent Agents.—At Inst. of Mech. Engineers, Storey's-gate, S.W.1. Jubilee meeting. 3.45 p.m.

Chemical Engineering Group.—Burlington House, W.1. "Problems of Emulsion Persistence," Dr. W. Clayton. 8 p.m.

Inst. of Electrical Engineers: N.E. Centre, Students.—Armstrong College, Newcastle-upon-Tyne. Address "Face to Face with Invention," by Mr. C. Turnbull. 7.15 p.m.

Inst. of Electrical Engineers: S. Midland.—Grand Hotel Birmingham. Annual dinner. 6.30 for 7 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. "Development of Modern Glass Bottle Making Machinery," Mr. F. G. Pascotti. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. Quarterly meeting. Paper, "Practical Boiler Testing," by Mr. F. Buckingham. 7.15 p.m.

North-East Coast Inst. of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Rejuvenation of Ships and their Machinery," by Mr. Andrew Hamilton. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, W.1. Discourse by Mr. H. Knox-Shaw. 9 p.m.

Soc. of Consulting Marine Engineers and Ship Surveyors: Scottish District.—39, Elmbank-crescent, Glasgow, C.2. Film, "Oxy-acetylene Welding and Cutting." 7 p.m.

Saturday, November 26th.

Inst. of Electrical Engineers: Midland Students.—Visit to the works of James Booth and Co., Ltd., Argyle-street Works, Nechells, Birmingham. 3 p.m.

Inst. of Metals.—Joint meeting with Inst. of British Foundrymen. Armstrong College, Newcastle-upon-Tyne. "New Demands on the Brass Foundry," Mr. J. Arnott. 7.30 p.m.

Monday, November 28th.

Bradford Engineering Society.—Technical College, Bradford. Cinematograph film. "Metal Treatment by the Oxy-acetylene Process." 7.30 p.m.

Royal Soc. of Arts.—John-street, Adelphi, W.C.2. Fothergill Trust Lecture, "Safety of Life from Fire," Lieut.-Col. Guy Symonds, D.S.O. 8 p.m.

Tuesday, November 29th.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Chromates and Chromium in Relation to the Corrosion of Iron," Dr. U. R. Evans. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C.2. "Transport Problems of the Empire," Mr. W. Rees Jeffreys. 4.30 p.m.

Wednesday, November 30th.

Inst. of Civil Engineers: Manchester and District.—36, George-street, Manchester. "Refuse Disposal," Mr. J. T. Kendal. 6 p.m.

Inst. of Welding Engineers.—College of Technology, Manchester. "Flame Cutting by Hand and Machine," Mr. C. G. Bainbridge. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C.2. "Recent Developments in Electric Lighting," Mr. W. J. Jones. 8 p.m.

Thursday, December 1st.

Inst. of Electrical Engineers.—Savoy-place, W.C.2. "Relative Fuel Economy of Electricity, Gas, Oil, and Solid Fuel as Heating Agents," Mr. A. H. Barker. 6 p.m.

Inst. of Locomotive Engineers.—At Inst. of Mech. Engrs., Storey's-gate, S.W.1. "Modern Articulated Steam Locomotives," Mr. Cyril Williams. 6 p.m.

Inst. of Metals: Birmingham Section.—University, Birmingham. "Oil-fired Furnaces," Mr. S. F. Unwin. 7 p.m.

Royal Aeronautical Society.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "Behaviour of Fluids in Turbulent Motion," Mr. A. Fage. 6.30 p.m.

Friday, December 2nd.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Thomas Low Gray Lecture, "Eight Years' Salvage Work at Scapa Flow," Mr. E. F. Cox. 6 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal Meeting. Discussion on Engineering Topics. 7.30 p.m.

Royal Inst. of Great Britain.—21, Albemarle-street, W.1. Discourse, "Radio Communications by means of Very Short Electric Waves," by the Marchese Marconi. 9 p.m.

Saturday, December 3rd.

Inst. of Electrical Engineers: Meter and Instrument Section.—Florence Restaurant, 56, Rupert-street, W.1. Annual dinner, 6.45 for 7 p.m.; reunion, 9.30 p.m.

Inst. of Municipal and County Engineers: Yorkshire District.—Wakefield. Meet at Town Hall. 1.45 p.m.

Tuesday, December 6th.

Inst. of Metals: Swansea Section.—Y.M.C.A., Swansea. "Some Industrial Pyrometry Problems," Dr. E. Griffiths, F.R.S. 6.15 p.m.

Thursday, December 8th.

Inst. of Metals: London Local.—Joint meeting with Inst. of British Foundrymen. Charing Cross Hotel, W.C.2. "Some Aspects of the Selection of Engineering Material," Mr. L. B. Hunt. 8 p.m.

Friday, December 9th.

Inst. of Electrical Engineers: N.E. Centre, Students.—Armstrong College, Newcastle-upon-Tyne. "Applications of Electricity on Ships," Mr. N. H. Denholm. 7.15 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Informal meeting. Discussion, "A Comparison between Communistic and Capitalistic Methods of Organisation," introduced by Mr. J. L. Hodgson. 7 p.m.

Inst. of Metals: Sheffield Local.—In Non-ferrous Section of Applied Science Dept. of University, Sheffield. "Degreasing and Cleaning (Vapour Cleaning)," Mr. W. F. Jesson. 7.30 p.m.

Inst. of Sanitary Engineers.—Abercorn Rooms, Great Eastern Hotel, E.C.2. Annual dinner. 6.30 p.m.

Junior Inst. of Engineers.—At Royal Soc. of Arts, Adelphi, W.C.2. Presidential Address, "The Future of Water Power in Great Britain," Sir Alexander Gibb. 7.30 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. "Glass and Glass-making," Mr. R. F. Taylor. 7.30 p.m.

Railway Club.—57, Fetter-lane, E.C.4. "Some Pre-war Cross-country Train Services," Mr. G. W. T. Daniel. 7.30 p.m.

Monday, December 12th.

Inst. of Metals: Scottish Local (Joint Meeting with Inst. of Engineers and Shipbuilders in Scotland).—39, Elmbank-crescent, Glasgow. "Ageing and Age-hardening in Metals," Dr. C. H. Desch, F.R.S. 7.30 p.m.

Royal Soc. of Arts.—John-street, Adelphi, W.C.2. Fothergill Trust Lecture, "Design and Construction of Buildings in Relation to Fire Risks," Mr. Maurice E. Webb. 8 p.m.

Tuesday, December 13th.

Diesel Engine Users Assoc.—Caxton Hall, S.W.1. "Report of Committee on Heavy-oil Engine Working Costs, 1931–32." 3 p.m.

Inst. of Metals: N.E. Coast Local.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. "Centrifugal Casting of Non-ferrous Alloys," Mr. F. W. Rowe. 7.30 p.m.

Thursday, December 15th.

Inst. of Metals: Birmingham Local.—University, Birmingham. "Welding of Copper," Mr. H. Martin. 7 p.m.

Friday, December 16th.

Inst. of Electrical Engineers: N.E. Centre, Students' Section.—Visit to the Optical Works of Sir Howard Grubb, Parsons and Co., Ltd., Newcastle-upon-Tyne.

Inst. of Electrical Engineers: N. Eastern.—Old Assembly Rooms, Westgate-road, Newcastle-upon-Tyne. Annual dinner. 7 for 7.30 p.m.

Railway Club.—Broad-street Station Restaurant. Twenty-sixth annual dinner.

Saturday, December 17th.

Manchester Assoc. of Engineers.—College of Technology, Sackville-street, Manchester. Conversazione and dance. 6.45 p.m.

Tuesday, December 20th.

Old Centralians.—Devereux Restaurant, Devereux-court, W.C.2. Luncheon. 1 p.m.

The Institution of Automobile Engineers.—We have come to regard the annual dinner of the Institution of Automobile Engineers as one of the very pleasant dinners we are invited to attend. This year's event, although the thirteenth, held on Friday last, November 18th, at the Park Lane Hotel, was no exception. Over three hundred and forty members and guests and their ladies attended, and a very delightful evening was spent. There were no long speeches. Following a few words by the President, Major C. G. Nevatt, who took the chair, the Very Reverend Dean Inge, who prefaced his remarks by the statement that as a railway shareholder and a pedestrian he did not think that he really approved of any of the Institution's activities, nevertheless found excellent reasons for proposing the prosperity of the automobile industry. To Mr. Leslie Walton, the President of the Society of Motor Manufacturers and Traders, fell the more serious task of dealing with the future of the industry, and the probable effects of the legislation now under consideration. The dinner was finished by 9.30, and after an interval for conversation, it was followed by a dance with a cabaret entertainment. We would congratulate Mr. Basil Joy on the excellent arrangements made and the great success which attended them.